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ABSTRACT

The second volume of the final report deals with the targeting system--one of a hierarchy of systems required to support the effective delivery of superior occupational education. It determines that program objectives match student training in occupations, that the best choice of occupations in which to train students has been made, and that the number and variety of programs in various regions fit those regions' needs. The elements of a targeting system for occupational education are: a body of information from which job market conditions and the effectiveness of occupational education can be determined, together with the processes required to utilize this information and make decisions. Topics covered in the report are: design considerations for a regional targeting system (information elements and design concepts, identifying service regions, assessing present and future regional manpower requirements, measuring system effectiveness, measuring the effects of population mobility), a proposed regional targeting system (design approach, an overview, information sources and software requirements, targeting system information outputs, using information outputs for first-level targeting decisions, further system design tasks), and other applications of the targeting system. A discussion of existing methods of assessing present and future regional manpower requirements is appended. (SA)

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THE COORDINATION OF PROGRAM PLANNING AND EVALUATION SYSTEMS FOR OCCUPATIONAL EDUCATION

VOLUME II: A TARGETING SYSTEM FOR OCCUPATIONAL EDUCATION

Submitted to:

The State Education Department of New York
Dr. Robert S. Seckendorf
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Albany, New York

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Authors' Note

The Targeting System, as it is described in this volume of the final report, was designed by Ben Josephson, Jr., Bertram L. Koslin, and Richard Pargament.

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I. Introduction

During the 1971 fiscal year, instruction leading to the acquisition or improvement of occupational skills will be delivered to some 600,000 residents of New York State by over 20,000 teachers through almost 3,000 programs at a cost approaching $300 million. By 1975, vocational education enrollment and costs are expected to increase by 40% from 1971 levels, and approximately 5,000 additional teachers will be required. The magnitude of the resources allocated to occupational education in New York State, and the broad scope of the effort, testify to the value which our society places on such training.

In the last analysis, the success of occupational education must be measured by the ability of its graduates to secure and hold jobs in the occupational areas for which they were trained. To achieve success in these terms, the State Education Department must have the capability:

- to characterize the present job market both regionally and state-wide, and to forecast changes in job market conditions;
- to design occupational education programs keyed to the present and future requirements of industry, and to identify the regions of the State in which these programs should be offered; and

- to measure the effectiveness of occupational programs from the employment experiences of occupational education graduates, and to modify the objectives and siting of these programs to enhance their effectiveness.

These capabilities--a body of information from which job market conditions and the effectiveness of occupational education can be determined, together with the processes required to utilize this information to make decisions--constitute the elements of a targeting system for occupational education.

A targeting system is one of an hierarchy of systems required to support the effective delivery of superior occupational education to the residents of New York State. The background and particular skills required to pursue different occupations successfully must be correctly identified and incorporated into the objectives of educational programs. The educational programs themselves must be effective in enabling students to acquire the background and skills needed for their chosen occupation. In addition, the program elements and instructional formats and methodologies used in occupational education courses must be selected to optimize student performance while keeping costs within budgeted limits. At all echelons, performance data must be generated to enable management to determine whether or not objectives are being met and to facilitate appropriate corrective action if necessary.

Thus, a monitoring system is required to manage program delivery and to insure that program content is consistent with program objectives. A reporting and evaluation system is needed to verify that program objectives are being met and that the best choice of alternative programs incorporating the same objectives has been made. Finally, a targeting system is required to establish that program objectives are well matched to the occupations or occupational clusters for which students are being trained, that the best choice of occupations in which to train students has been made, and that the number and variety of programs offered in different regions of the State are appropriate to those regions' needs.

Riverside Research Institute has investigated various aspects of all three of these interrelated systems for the New York State Education Department under contract number C-50484. This volume of the final report deals with the Targeting System, and presents a design proposal for a new regional targeting system for occupational education in New York State. Reports of Riverside's work on a reporting and evaluation system and on a monitoring system for occupational education can be found elsewhere.*

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* The Coordination of Program Planning and Evaluation Systems for Occupational Education. Volume I: A Reporting and Evaluation System for Occupational Education. Volume III: A Monitoring System for Occupational Education.

In developing the Targeting System design discussed in the remainder of this report, emphasis has been placed on targeting offerings in occupational education to present and projected job market conditions rather than on targeting these offerings to various groups within the population (e.g., the disadvantaged, the unemployed, the handicapped, or students at various educational levels). These two aspects of targeting can be viewed as sequential: success in bringing sustained employment to groups such as the disadvantaged or the unemployed through occupational education is contingent upon the demonstrated effectiveness of occupational education in providing training which is matched to job market conditions and which enables its graduates to secure and hold good jobs. Once developed, however, the Targeting System proposed here could be extended (additional information elements would be required) to enhance the impact of occupational education on particular population groups in need of its services.

A variety of problems have arisen in connection with the targeting of offerings in occupational education. In Section II of this report, these problems are examined and design considerations for a regional targeting system are discussed. In Section III, the new regional Targeting System is proposed. The design is not fully executed, but the information sources and outputs of the system are described in detail, and examples are given showing how the information outputs might be used in

making targeting decisions. An important element of this targeting system is a new data base, to be maintained by the New York State Department of Taxation and Finance. This data base promises to yield accurate and trustworthy assessments of current job market opportunities, to facilitate more accurate projections of future manpower requirements, and to allow meaningful measures of system effectiveness and mobility to be made.

Section IV briefly discusses other applications of the Targeting System. An appendix to the report contains a summary of the results of an extensive review of existing methods of estimating current and future regional manpower requirements.

II. Design Considerations for a Regional Targeting System

A. Preface. Information Elements and Design Concepts

An impressive amount of information about the characteristics of the population and the economy in different regions of the State must be assembled if regional offerings in occupational education are to be targeted effectively. The members of the work force must be identified, located within different regions of the State, and their occupations determined. The distribution of occupations and the utilization of these occupations by employers within each region must be established. The employment history of graduates of occupational programs--where they go, and what kind of jobs they get--must be compiled. The effects of impending changes in regional economic conditions must be assessed. All of this information must be as accurate as possible and accessible at reasonable cost. Finally, appropriate techniques must be identified or created so that present and future regional manpower requirements, system effectiveness measures, mobility indices, and other important quantities which affect targeting decisions can be calculated from this body of information.

The nature of the targeting decisions which have to be made should determine the number of, and the specifications for, the quantities which must be calculated from the data base. The number and variety of decisions is staggering.

However, as the discussion in Section III E will show, even the simplest decisions cannot be made on the basis of manpower estimates or effectiveness measures or mobility indices alone. Appropriate quantities must be combined systematically in order to reduce uncertainty about the consequences of targeting decisions.

In order to guide the identification and definition of information outputs which occupational education targeting decisions require, three interrelated levels in the targeting decision structure have been identified.

First level of the decision structure. This level encompasses decisions related to specific occupational programs offered in a particular region, and includes consideration of the effects which programs offered in one region may have on the manpower situation in contiguous regions. Examples of decisions on this level are decisions to expand or discontinue specific programs within a region in the light of regional manpower needs, decisions to upgrade programs which have not been completely effective in providing the occupational skills for which a regional need exists, and decisions to introduce new programs into the region.

The effects of regional programs on the manpower situation in contiguous regions may be important if program graduates from one region are finding training-related employment in contiguous regions. Decisions to discontinue such programs,

even if the region in which the programs are offered has small need of the graduates, may be inappropriate because of the education-induced mobility of the programs' graduates.

Second level of the decision structure. Decisions involving the mix, or number and variety of programs offered within a particular region are characteristic of this level. Again, the effects of programs on the manpower situation in contiguous regions are considered. Decisions at this level involve regional budgetary constraints which may limit the number of programs which can be offered, considerations of the relative importance of different occupations to the regional economy, and trade-offs among programs providing training primarily for different occupational clusters.

An example of a second level decision is whether or not to introduce a new program in, say, animal care if graduates of other programs, not designed to provide training in animal husbandry, are being employed to fill job openings for animal care specialists. Note that second-level decisions may act to modify first-level decisions. In the above example, budgetary restrictions may preclude the introduction of a new animal care program even though a first-level decision to install such a program has been made based on regional manpower needs, and even though the programs currently providing graduates to work as animal care specialists are not providing all the entry-level skills required for the animal care field.

Third level of the decision structure. Decisions at this level involve State-wide manpower needs, State growth objectives and State budgetary constraints. Decisions at this level may act to modify both first- and second-level decisions.

Careful consideration of the nature of the first- and second-level decisions which must be made to target occupational education programs has led to the view that sound regional manpower assessment requires regional information (rather than regionalized federal and state data), and has produced new conceptions of effectiveness and mobility which are consistent with the requirements imposed by targeting decisions. These design considerations are discussed in the remainder of this Section, together with a review and evaluation of existing techniques and sources of data for assessing regional manpower requirements, for measuring the effectiveness of occupational education and for determining population mobility patterns.

B. Identifying Occupational Education Service Regions

Prior to developing a system to target offerings in occupational education, a rational basis for identifying geographic regions for planning purposes must be established. Clearly, neither the statistical, economic, educational, planning, nor political regions established by various agencies necessarily correspond to the best choice of regions for occupational educational planning purpo es.

Since occupational educational programs will be offered at educational centers such as Boards of Cooperative Educational Services (BOCES) facilities and community colleges, it seems appropriate to discuss planning regions in terms of the boundaries of the "regions of influence" which these educational centers serve.

For students at the elementary and secondary level, the boundaries of BOCES service regions are fixed by law to be the boundaries of the local school districts comprising each BOCES region. For students receiving continuing and adult education, however, the boundaries of regions served by BOCES and community college facilities could be established in terms of pertinent characteristics of the persons actually using the centers. For adult students, the best approach would be to define the service regions for different centers in terms of the educational needs of those who will have to travel to the centers to receive instruction.

Some segments of the population are more transportation-deprived than others (or have what a social psychologist has termed a more restricted "life space"). Therefore, it would be desirable to identify several different service areas for each center according to the type of occupational education sought by the different segments of the population using the center. Thus, a particular educational center could have, simultaneously, several geographic regions of influence with different boundaries. These boundaries will depend on the average distances that different segments of the population will travel to obtain instruction of interest to them at the center.

Regardless of whether service regions are defined by law or travel patterns, it is preferable to associate manpower and other information with these centers rather than to fit the centers into various statistical, political or economic regions defined by various agencies for a variety of purposes which did not include the targeting of occupational programs. Furthermore, it should be possible to make manpower assessments, forecasts, mobility calculations and effectiveness determinations independently of how service regions are defined, and with equal ease and precision for any and all definitions of service regions.

C. Assessing Present and Future Regional Manpower Requirements

A targeting system should permit accurate estimates of present and future manpower requirements to be made for occupational education service regions. Such estimates are essential if occupational education offerings are to be tailored to a changing job market.

1. Review and evaluation of existing data bases and techniques

Riverside has reviewed and evaluated seven existing methods for determining present and future regional manpower requirements. These seven methods were evaluated according to the following qualitative criteria:

- Adequacy of the data source.

  Particular attention was devoted to identifying errors in and limitations of the data source which might result in inaccurate manpower assessments or preclude obtaining manpower estimates for a broad range of occupations.

- Adequacy of sample data and statistical methods used.

  Most existing methods for determining manpower requirements employ some form of sample data for job market evaluation. The sample data used should yield verifiably accurate results when appropriate statistical methods are applied. In addition, it must be possible to estimate the

size of the sample error so that the stability of manpower estimates based upon the sample data can be determined.

- Suitability of the method for producing accurate regional estimates.

  Occupational education is typically delivered at a subcounty level. Assessments of current labor market conditions and projections of labor market trends are commonly made for the nation as a whole, or for states. Various techniques are then used to make regional adjustments. The technique used--and the data--should produce estimates which are reasonably trustworthy at the subcounty level. However, national and State labor market trends must also be considered since occupational education graduates are not necessarily being prepared to work exclusively within the service region where they receive their education.

- The cost for gathering the required data and maintaining the data base should not be excessive.

  The establishment and management of a data base from which regional manpower needs can be estimated is an important element of the Targeting System, but such a data base should

permit accurate estimates to be made for the smallest possible amount of money.

All of the methods reviewed were judged to be of very limited use for targeting occupational education program offerings. A brief summary of each method and Riverside's evaluation of it is given below. Additional details are given in the appendix to this report.

a. The method of regionalizing nationwide manpower requirements.

Output: Current manpower assessments and forecasts.

Data Source: Principally U.S. Census. Also other reports and surveys.

Description: U.S. Bureau of Labor Statistics produces National Manpower Projections, assuming steady rates of economic and population growth, employment and technological advancement. Other organizations (e.g., N.Y.S. Dept. of Labor) regionalize these projections, assuming that state and local rates of economic and population growth, employment, etc., are much the same as national rates.

Cost: Low, since national projections and regionalized data are provided currently by state and federal agencies.

Evaluation: Low suitability for regional targeting.

- Census data inaccurate, reporting cycle too long (10 years), precision of reporting occupations poor.
- Assumption of steady national growth rates is poor (actual conditions differ).
- Local patterns and growth rates vary, and do not reflect national trends accurately.
- Discrepancies cannot be determined without expensive local surveys.

b. The method of the employer survey.

Output: Current manpower assessments and forecasts.

Data Source: Employer surveys of current openings and future requirements.

Description: Results of surveys are tabulated by occupation.

Cost: Very high to obtain accurate data for a large number of occupations.

Evaluation: Low suitability for regional targeting.

- Method is potentially capable of yielding accurate results for current assessments in regions of various sizes, but periodic survey and data analysis costs would be high in order to realize potential.
- Employers have not been able to predict future needs accurately, so forecasts can be expected to be inaccurate.

c. The method of persistent openings.

Output: Current manpower assessments and forecasts.

Data Source: Quarterly reports from employment services on unfilled job openings, plus U.S. Dept. of Labor national trend data.

Description: Job openings which remain unfilled for 30 days are used to estimate manpower shortages if openings in particular occupations persist for several quarters. Forecasts are made by combining information on persistent openings with national trend information.

Cost: Relatively low.

Evaluation: Low suitability for regional targeting.

- Data source does not give information on all occupations.
- Data from employment services varies by area, industry and occupation.
- Openings at employment agencies may persist even when there are no real manpower shortages.
- Method only predicts rapid occupational expansion. It is insensitive to contractions in manpower requirements, and probably insensitive to slow job market expansion.

d. Computer simulation of an input-output model of a local economy.

Output: Manpower forecasts.

Data Source: Various data on the structure and functioning of the economy.

Description: Input-output model of the economy is simulated on a digital computer. Employment levels are assumed to be directly related to industrial output, and the known occupational composition of industries is used to forecast employment levels within particular industries. Regional forecasts are obtained from regional models, or by regionalizing national forecasts.

Cost: High.

Evaluation: Low suitability for regional targeting.
- Regionalizing national forecasts is inaccurate (see method a).
- Developing regional models yielding sufficiently detailed results to be useful for targeting is very difficult and too expensive.

e. The method of regression on indicators.

Output: Current manpower assessments and forecasts.

Data Source: Economic indicators and historical data giving manpower requirements for different industries.

Description: Statistical correlations between economic indicators or combinations of indicators and historical manpower requirements are used to assess current and future manpower requirements from current values of the indicators.

Cost: Variable. Difficult to estimate.

Evaluation: Low suitability for regional targeting.

- Current manpower assessments and forecasts have low credibility.
- Selection of appropriate indicators is problematical.
- Regional regression equations cannot be developed at this time because regional economic indicators are unavailable, and state and local indicators cannot be applied sensibly on the regional level.

f. The method of planned industrial construction.

Output: Manpower forecasts.

Data Source: Plans for industrial construction, plus the occupational composition of industries.

Description: Increased manpower needs are forecast from the announced purposes to which new industrial facilities are to be put, and the known occupational composition of the prospective occupants of these new facilities.

Cost: Low.

Evaluation: Low suitability for regional targeting.
- Method is highly inaccurate when used independently.
- New buildings are often not used as intended.
- Occupancy level in new buildings is variable.
- Method is insensitive to contractions in manpower requirements.

g. The method of more advanced economies.

Output: Manpower forecasts.

Data Source: Historical records of manpower requirements for different industries in various stages of growth.

Description: Manpower forecasts for a particular industry within a region are obtained by using historical data from other regions in which that industry is in a more advanced stage of development.

Cost: Low.

Evaluation: Low suitability for regional targeting if used alone, but possibly useful if employed in conjunction with other information.

- Economic conditions in a region for which manpower forecasts are being sought may differ significantly from the previous economic conditions in the "advanced" region.

2. Informational requirements

Certain informational requirements of the Targeting System can be inferred from the preceding review and evaluation:

- sources of information giving the occupational composition of industries and the occupational composition of the work force should be regional. These sources should be directly accessible by the Targeting System. The use of regionalized State or Federal data should be avoided in the interest of obtaining accurate regional manpower assessments and forecasts;
- regional data sources should be sensitive both to contractions and expansions in manpower requirements for all occupational categories;
- all occupational categories should be represented in the data base;
- it should be possible to update the data base at intervals which are less than or equal to the planning cycle used to adjust occupational program offerings.

D. Measuring System Effectiveness for Occupational Education

1. Design concept

It was said in Section I that the success of occupational education must be measured by the ability of its graduates to secure and hold jobs in the occupational areas for which they have been trained. However, in reducing this goal to operational terms, care must be exercised to insure that the effectiveness of the occupational education system is being measured, and that the measures chosen are insensitive to effects, such as wars and recessions, which are beyond the power of occupational education to control. While occupational education must make every effort to forecast economic trends and to adjust its offerings accordingly, it cannot be expected to be clairvoyant and to foresee all major economic perturbations. Furthermore, over periods of time, graduates of particular occupational programs may change their occupations for a variety of personal reasons which occupational education planners cannot possibly anticipate.

A determination of system effectiveness for a particular occupational program requires that two separate factors be measured: job-relatedness, or the degree to which the skills acquired in the occupational program are being used in the jobs held by the program's graduates; and penetration, or the extent to which graduates of the occupational program are hired to fill job openings which occur in the occupations

for which they were trained. Both of these measures are discussed briefly below. Precise definitions for measures of job-relatedness and penetration are given in Section III.

a. Job-relatedness

Graduates of occupational programs may not be able to obtain jobs in the occupations for which they were trained even though job openings exist in these occupations. Although this situation could occur because the number of graduates exceed the number of training-related job openings, it is also possible that the job-relatedness of their training is low, i.e., that the educational programs did not properly prepare the graduates with the occupational skills currently required by the market. For example, if a region requires more auto mechanics, and if a corresponding program is set up at the region's educational center, it does not follow that graduates of the program will be successful in securing jobs as auto mechanics. The Targeting System should be capable of at least identifying the possibility that qualified graduates of occupational programs were being inappropriately educated for existing jobs.

The Targeting System should also be able to determine the degree of relatedness between occupational programs and all occupations or occupational clusters for which program graduates are being hired. Such information could be of importance in making second-level decisions. For example,

if budgetary constraints preclude the introduction of a new program, limited relatedness between an existing program and occupations in which regional job openings exist may be regarded as sufficient to satisfy regional manpower needs.

b. Penetration

The number of graduates of particular occupational programs may not be well matched to current manpower requirements in the occupations for which they were trained, even though their training is strongly related to these occupations. The number of job openings for auto mechanics which occur in a region during, say, a period of one year following the graduation of a class from a program designed to train auto mechanics, may be much larger (or much smaller) than the number of graduates from the program. A decision to expand (or contract) the program may be appropriate. The Targeting System should provide estimates of the number of employment openings which have occurred within different occupations during a particular time interval, and determine the extent to which these openings have been filled by graduates from corresponding occupational programs.

The Targeting System should be able to determine the penetration of occupational education graduates into occupations of varying degrees of similarity to their training in order to support second-level decisions of the type referred to in the preceding discussion. Inter-regional penetration

determinations (i.e., the extent to which graduates of occupational programs in one region are penetrating the labor market in contiguous regions) should also be available from the Targeting System.

2. Review and evaluation of existing effectiveness measures

The Vocational Educational Data System (VEDS) currently requires follow-up surveys of graduates of occupational programs to try to determine, among other things, whether graduates have been employed in occupations for which they were trained. These surveys are administered by BOCES centers and by local educational agencies (LEAs). Forms are mailed to occcupational program graduates, who are asked to complete and return them.

These surveys have not been successful in producing information upon which to base assessments of the job relatedness of occupational programs. Responses from graduates have been fragmentary, and the LEAs, which are responsible for a large fraction of the occupational education graduates in New York State, do not have sufficient resources to conduct surveys which will produce reliable information.

The cost for surveys which would produce reliable information from which to measure the job-relatedness of occupational education programs is likely to be unacceptably high. In addition, no measures of penetration are possible

from the survey data, nor are any measures of penetration available from other sources.

Riverside has concluded that no reliable measures of the system effectiveness of occupational education exist at present.

3. Informational requirements

- The employment experiences of all occupational graduates, specifying the occupational categories of the jobs they obtained as well as the job locations, should be available from the Targeting System data base. The Targeting System should be able to determine the job-relatedness of all occupational programs to the occupations for which the graduates are being trained.
- The Targeting System should be able to determine the penetration of the labor market by graduates of occupational programs for all degrees of occupational similarity and between contiguous regions.

E. Measuring the Effects of Population Mobility

1. Design concept

The degree of mobility of the population--the extent to which different persons will relocate to find jobs if there are no jobs available in their occupation in the region in which they live--depends on many factors such as occupation, social status, income, race, ethnicity and age. The data base of the new Targeting System proposed in this report is sufficiently comprehensive and the information in it is sufficiently detailed to calculate population mobility as a function of occupation or income. This information could be useful to occupational education planners in many ways. However, for purposes of making targeting decisions for occupational education, occupational mobility indices do not appear to be important.

What is required is a measure of the education-induced mobility of graduates of occupational programs: the extent to which graduates will move to fill job openings in regions contiguous to the region where they received their training. Another useful quantity to measure would be social immobility: the unwillingness of certain elements of the population to move to contiguous regions even if job openings exist there and they cannot find employment near home in their chosen occupations. These types of mobilities are discussed below, and measures for induced mobility and social immobility are defined in Section III.*

* For completeness, a measure for occupational mobility is also defined in Section III.

a. Induced mobility

The jobs obtained by a significant number of graduates of certain occupational programs may show that they are finding jobs related to their training outside the service region in which they were trained. These programs should probably be continued even if few training-related jobs are available in the region in which the programs are being offered. In effect, such a situation means that the match between regional manpower requirements and programs offered at a regional center can be looser than regional manpower requirements alone would indicate was desirable.

b. Social immobility

Decisions concerning whether or not to offer particular occupational programs in a region when regional manpower assessments indicate that there is no pressing need for such graduates may be illuminated by knowledge of the social immobility of segments of the regional population.

Suppose that there is a need for bookkeepers in a particular region, and that the number of graduates of the bookkeeping program in that region is insufficient to meet the need. The commencement or expansion of bookkeeping programs in contiguous regions (where, let us say, there is no shortage of bookkeepers) might be justified if there was some evidence that the graduates of these programs would migrate into the region where there is a job shortage and fill the available job openings.

Some segments of the population of certain regions may display low education-induced mobility because of strong kinship ties, ethnicity, or other factors. Their immobility may be correlated with attitudes toward living in urban as opposed to rural surroundings. If detailed information were obtained from occupational students and entered into the Occupational Education Reporting and Evaluation System's data base (social security number, parents' occupation, parents' address, ethnicity, members of the family living in the region, etc.), and if the occupations of these students and the locations of their jobs were obtained from the Targeting System's data base for several years following their graduation. it would be possible to investigate the existence of stable relationships between the characteristics of persons in certain regions (parents' occupation, family size, ethnicity, etc.) and the probable mobility that they will or will not display after graduating from occupational programs. If stable relationships were found to exist, the social immobility of different population segments in different regions could be determined, and some of the uncertainty concerning the probable outcome of installing programs in one region to meet manpower needs in contiguous regions would be reduced.

Information which characterizes social immobility would also be useful to guidance counselors. Students displaying

characteristics which suggest high social immobility could be encouraged to enter programs designed to meet manpower needs only in the region where the students reside.

2. Review and evaluation of available mobility information

Riverside concurs with several investigators who have observed that the fund of basic information concerning mobility is inadequate for regional planning purposes (Parnes, 1969; Somers, 1968; Wingeard, 1969). Most of the limited information currently available is based upon census data and is not applicable regionally. No information concerning induced mobility or regional social immobility is available.

Jaffe and Carleton (1954) have applied cohort analysis to successive censuses to measure movement out of occupations. More recently, the Bureau of Labor Statistics has used census data to compute net in-movement and out-movement for major occupational groups (Occupational Mobility, 1967). On the State level, the New York State Department of Commerce has published information on inter-county commutation patterns (Commuting from County to County, 1970). Some more specialized studies are also available (e.g., Palmer, 1954).

Riverside has concluded that no mobility information which would be of any use in making decisions related to the targeting of occupational education programs exist at present.

3. Informational requirements

- The Targeting System data base should contain information with which to determine the induced mobility of the population within any occupational category. Specifically, it should be possible to identify all graduates of occupational education programs who have joined the work force, to determine the occupational categories and locations of their jobs, to determine the region in which they received their training, and to identify the program from which they graduated.
- The Reporting and Evaluation System data base should be augmented to include such student information as race, ethnicity, family size and number of close friends in the region, together with information from which student attitudes related to relocation can be determined.

III. A Proposed Regional Targeting System for Occupational Education

A. Preface. Design Approach

All of the existing manpower assessment and forecasting methods present problems of accuracy, cost, sensitivity to regional variations, or comprehensiveness of the manpower information provided. In addition, even if there were no problems of validity associated with the estimates that each method produces, it is not clear how manpower information alone can lead to effective regional targeting decisions.

In order for occupational program offerings to be targeted accurately to regional and statewide manpower requirements, manpower information must be combined systematically with other relevant factors such as measures of induced mobility (which do not exist at present) and measures of system effectiveness. For forecasting purposes, such information should be organized so that it can be used effectively in conjunction with information obtained from specialized studies (produced by public and private sources) dealing with changing national and regional economic conditions.

In view of the difficulties of applying existing methods of manpower estimation to making regional targeting decisions, and in the absence of measures of induced mobility and system effectiveness, the design of a new, comprehensive Targeting

System has been undertaken. The principal source of information for this new Targeting System is a computerized data base, to be maintained by the New York State Department of Taxation and Finance. This data base fulfills all of the informational requirements obtained in Section II for a regional targeting system, and has many other important potential applications as well.

The approach taken to the design of the Targeting System is one which focuses on the jobs obtained by graduates of occupational programs as the key to Targeting System performance. This approach provides a framework for iterating all elements of the Targeting System design over successive years to improve the effectiveness of targeting decisions, and should provide occupational students with a better chance to succeed in their chosen occupations.

The full design of a Targeting System for occupational education which will support decisions at all levels (see Section II A) will require substantially more effort than was intended and provided for in the contract under which the work reported here was done. Consequently, resources have been devoted to developing Targeting System design specifications related to first-level decisions. The requirements for second-level decisions have been given only preliminary consideration. Third-level decisions have not been considered at all. In accordance with State Education Department plans,

and following the review and acceptance of the proposed design concepts, additional support will be sought by the Department to permit the Targeting System design to be completed.

B. An Overview of the Occupational Education Targeting System

Figure 1 shows a schematic diagram of the proposed Targeting System. The major sources and different types of information required are indicated.

The computerized data base, which would be maintained by the State Department of Taxation and Finance, contains detailed information, extending over many successive years, on all members of the work force and all employers in New York State.

In order to define the regions referred to in the figure, the Reporting and Evaluation System's data base* would provide information on the geographic distribution of adult populations served by educational centers (e.g., BOCES facilities, community colleges), or the required information could be obtained by survey.** For populations at the elementary or secondary level, service regions are fixed by law and the required information is available from current files of BOCES' boundaries.

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* The Coordination of Program Planning and Evaluation Systems for Occupational Education: Volume I. A Reporting and Evaluation System for Occupational Education.

** In the event that some new center is planned, it is possible to use survey methods to determine the geographic region which would most probably be served. It is less costly and probably more valid to estimate, from the data base which will exist when the Occupational Education Reporting and Evaluation System is fully implemented, which elements of the population will be served by the new center. These estimates would be based on algorithms concerning the distances which students travel to attend existing centers in the area, and the travel patterns of segments of the population which are most likely to attend programs given at the new center.

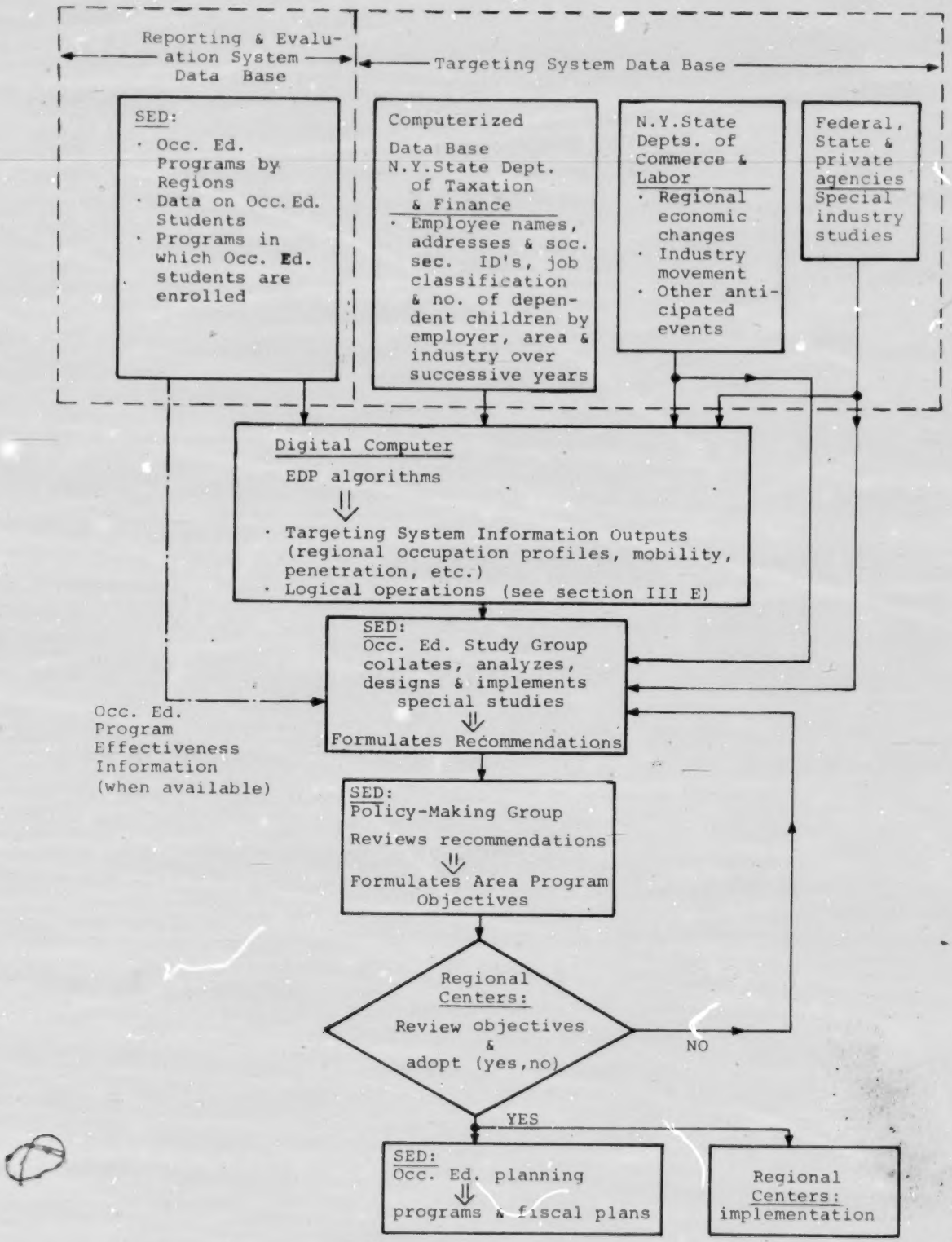
Reporting & Evaluation System Data Base
Targeting System Data Base
SED:
· Occ. Ed. Programs by Regions
· Data on Occ. Ed. Students
· Programs in which Occ. Ed. students are enrolled
Computerized Data Base N.Y.State Dept. of Taxation & Finance
· Employee names, addresses & soc. sec. ID's, job classification & no. of dependent children by employer, area & industry over successive years
N.Y.State Depts. of Commerce & Labor
· Regional economic changes
· Industry movement
· Other anticipated events
Federal, State & private agencies
Special industry studies
Digital Computer
EDP algorithms
· Targeting System Information Outputs (regional occupation profiles, mobility, penetration, etc.)
· Logical operations (see section III E)
SED:
Occ. Ed. Study Group collates, analyzes, designs & implements special studies
Formulates Recommendations
Occ. Ed. Program Effectiveness Information (when available)
SED:
Policy-Making Group
Reviews recommendations
Formulates Area Program Objectives
Regional Centers:
Review objectives & adopt (yes,no)
NO
YES
SED:
Occ. Ed. planning
programs & fiscal plans
Regional Centers:
implementation

Fig. 1: Schematic Functional Flow Chart of the Occupational Education Targeting System's Annual Planning Cycle

The Reporting and Evaluation System would also supply descriptive information on all occupational students (e.g., social security numbers, addresses), identify the programs in which occupational students are enrolled, and provide information on the occupational programs currently being offered in different regions of the State. Eventually, the Reporting and Evaluation System will provide program effectiveness measures--how well students are learning and retaining the skills, concepts and attitudes related to each program's objectives--for each occupational education program.

Information useful for forecasting future regional manpower needs (e.g., economic changes, industry movements, special industry reports) would be obtained from the New York State Departments of Labor and Commerce, and from other public and private agencies. This information would be used by the computer for forecasting manpower requirements and would also go directly to the Study Group for analysis and for incorporation into long-range plans for occupational education.

A digital computer would be programmed to calculate the Targeting System information outputs (e.g., regional occupational profiles, mobility indices) and to perform the logical operations discussed in Section III E. Sensible computer output formats would be developed so that only significant information, required for planning and justifying changes in regional program offerings, would be reported to the Study Group.

The proposed Occupational Education Study Group would analyze the information provided to them, and perhaps initiate special analytic studies (e.g., occupational profiles of graduates of particular programs in particular regions) to further reduce the uncertainties associated with arriving at decisions. On the basis of the analyses, the number and variety of occupational education programs for each region would be evaluated, and recommendations for regional adjustments of occupational program offerings would be formulated.

These recommendations would be reviewed, and modified if necessary, by the SED Occupational Education Policy Group. The Policy Group would formulate area objectives for educational service regions throughout the State from the recommendations submitted to them. These objectives would then, in turn, be submitted for review to BOCES Centers, community colleges, and other regional public agencies responsible for the delivery of occupational programs.

As shown in Figure 1, the regional centers may choose either to adopt the objectives or to propose modifications to them based upon documented local experience or other factors. If the objectives are adopted, appropriate planning and program implementation processes take place at the regional level with the usual State support.

If the regional centers reject the objectives, require

modification of them, or request further clarification of the analyses upon which the objectives are based, the regional centers would communicate their perspectives to the Occupational Education Study Group. The Study Group would provide further clarification or, if necessary, carry out additional studies to develop alternative recommendations. For example, the Study Group might recommend a program which requires teaching personnel not currently available within a particular region, or guidance personnel might believe that there is insufficient local interest in a particular recommended program to justify its installation or continuation.

In such cases, the issues would be presented to the Study Group for re-analysis. The Study Group would modify its recommendations where necessary and submit the revised recommendations to the SED policy group. The SED policy group would consider these new recommendations and revise the regional objectives as required.

This process would be carried out annually. The objectives would be reflected in the New York State Plan for the Administration of Vocational Education submitted to the United States Office of Education to fulfill the requirements of the Vocational Education Amendments of 1968.

C. Information Sources and Software Requirements

1. The computerized data base

The Targeting System's information outputs, depend upon the development and maintenance of a substantial computerized data base. The data base would be constituted primarily from information furnished by employers to the New York State Department of Taxation and Finance. The data base would be updated annually as part of the State's tax collection procedures. The elements of this data base and their availability are described below.

a. Names, addresses and social security numbers of the New York State labor force

This information is currently maintained by the New York State Department of Taxation and Finance. Addresses (including zip codes) and social security numbers of all individuals employed in New York State who earn at least six hundred dollars per year are currently on record. The data are maintained on magnetic tape which is keyed to each taxpayer's social security number. Records are maintained for many years, so that time-series statistics can be used with this data to detect trends of various kinds.

The Department of Taxation and Finance estimates that a very small percentage of the social security numbers in their records is invalid. However, a small number of errors would present no problem for targeting calculations,

since these calculations are based on grouped rather than individual data. Moreover, subsequent to an Executive Order which directed all federal agencies to use the social security number instead of issuing an alternative number, the Social Security Administration has cooperated with federal and state agencies to validate individual social security numbers on a need-to-know basis.

b. Employee occupational information

A verbal description of employee occupation is currently requested on both State and Federal income tax return forms. However, the Targeting System data base requires numeric labels for occupations, and none are currently used by the Department of Taxation and Finance.

A suitable source of numeric labels is the Dictionary of Occupational Titles (DOT), published by the United States Department of Labor. The DOT is the product of carefully executed research carried out by job analysts and other research personnel in federal and state labor departments. Considerable attention has been paid to the training and testing of these job analysts to insure that numeric assignments are reliable. In addition, sampling procedures are employed to identify any regional or industry differences in the occupational functions associated with particular job classifications.

The DOT defines approximately 35,000 jobs using

a hierarchical nine-digit code. This code is illustrated in Table 1. The first digit of the code is the job category. There are nine job categories specified in the DOT. The category (2) for the jobs specified in Table 1 is entitled "Clerical and Sales Occupations." The second digit of the code is the division. There are eighty-four job divisions subsumed under the nine job categories. The jobs specified in Table 1 are in the first division of the second category, "Computing and Account-Recording Operations." The third digit of the code is the group. Two groups are illustrated in the table, Bookkeepers (210) and Bookkeeping Machine Operators (215). The first three digits of the DOT (i.e., categories, divisions and groups) define a total of 603 generic job titles.

The fourth, fifth and sixth digits define the complexity of the job in relation to data, people and things respectively. The complexity scales are also shown in Table 1.* The seventh, eighth and ninth digits are a suffix used when particular jobs require unique identification (e.g., when Bookkeeper I must be distinguished from Bookkeeper II).

In order to calculate Targeting System information outputs requiring employee occupation information, it should be sufficient to include only the first three digits of the DOT code in the computerized data base. As indicated

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* See Appendix A, Volume II of the Dictionary of Occupational Titles for a discussion of these scales.

Table 1

Examples of Occupational Codes from the Dictionary of Occupational Titles

DOT Job Title	Category	Division	Group	Data	People	Things	3 Digit Suffix
Account information clerk (Light, heat & power)	2	1	0	3	6	8	010
Insurance clerk (Medical service)	2	1	0	3	6	8	014
Account-classification clerk (Clerical)	2	1	0	3	8	8	010
Bookkeeper I (Clerical)	2	1	0	3	8	8	022
Bookkeeper II (Clerical)	2	1	0	3	8	8	026
Bookkeeping Machine (Operator I (clerical))	2	1	5	3	8	8	010
Bookkeeping Machine (Operator II (clerical))	2	1	5	3	8	8	014
Payroll clerk (Clerical)	2	1	5	4	8	8	010

previously, the first three digits of the code define a total of 603 classes of jobs.

Since this job list is already hierarchically organized by categories, divisions and groups, it would not be difficult to organize a series of simple directories which employers could use to determine the DOT code for the occupations of their employees. This information could then be entered on the W-2 form which is submitted to the State Department of Taxation and Finance when the employee's State income tax return is filed. Since the income tax return already contains employer and employee addresses, the employee's social security number, and other needed information, all data could be simultaneously entered into the system in one convenient operation.*

c. Employer information

The New York State Department of Taxation and Finance maintains records of the name, address (including zip code) and Federal identification number of all employers doing business in New York State. The Department currently has the capability of summarizing employer information by

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* Interviews with personnel at the State Department of Taxation and Finance revealed that it is not possible currently to identify employees with employers. However, this is hardly an insurmountable constraint. The employer's address, name, and Federal identification number are associated with the employee's name and social security number on the W-2 form.

county and by zip code. Unfortunately, the Federal identification numbers contain only tax region information (first two digits). These regions are probably not useful for targeting purposes.

Ideally, the Standard Industrial Classification (SIC) used by the Bureau of the Budget should also be maintained in the Department's employer records. The SIC numbers could then be included in the Targeting System data base, and precise, regionalized industry-by-employment studies could be carried out. The SIC is a four-digit, nested hierarchical code: particular industries are nested within industrial groups which are in turn nested within major groups.

Riverside's interview with representatives of the Department of Taxation and Finance revealed that the Department does not collect SIC data from employers but does collect SIC data with sales tax returns. The inclusion of SIC codes in the Targeting System data base is not essential, since industries within regions may be traced by zip code and Federal identification numbers. However, the inclusion of the SIC is certainly feasible and would substantially augment the utility of the Targeting System data base for a variety of purposes. The inclusion of SIC information on employees' tax returns would also be useful, and is at least as easy to include as DOT numbers.

d. Other information elements

Once some experience has been acquired with the Targeting System data base, it may be useful to include other information elements.

One information element which would be useful is the number of dependent children claimed by each employee. It would be possible for the New York State Department of Taxation and Finance to request this information on the employee's W-2 form. This suggestion implies that the employer would record this information. Knowledge of the number of dependent children would permit the calculation of occupational mobility indices specifically for segments of the population whose children require educational services.

2. Other information sources: regional reports, special industry studies, and industrial intelligence

Special reports can supplement the information which is contained in the Targeting System's computerized data base. The amount of material available that could have utility for forecasting regional manpower needs is substantial.

Special reports could be drawn from public as well as private sources. An example of potentially useful sources of information are the State and Federal Commerce Departments. The U.S. Department of Commerce compiles reports on changes in commerce and economic trends, reports on county business patterns, special studies for high growth industries, and

ten-year profiles for approximately four hundred specific industries. These and other studies are carried out primarily to facilitate the administration of the Department's own programs, but they have potential utility for occupational education planning.* The New York State Department of Commerce publishes a series of regionalized Business Fact Books which could supply significant information. In addition to these data, potentially valuable reports are prepared for agencies of the Department of Commerce by its consultants.**

A potential private source of useful information is the New York Chapter of the Society of Industrial Realtors. This organization could provide information on new industries moving to an area, expansion plans, and so forth. Although such information cannot be used independently for targeting purposes (as indicated previously), it may be combined with other available sources to arrive at stable regional recommendations.

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* Since most of these studies supply information through the Standard Industrial Classification code, maximal utility and efficiency could be obtained from these studies by including the Standard Industrial Classification code in the Targeting System data base.

** A relevant example is a recent report on industrial location as a factor in regional economic development prepared for the Economic Development Administration.

3. Targeting system software requirements

The expense and time associated with developing the computer software required for manpower analyses and maintenance of the Targeting System data base would not be substantial. Since targeting system data may be maintained according to formats that are used for data base maintenance throughout the computer field, suitable software may already exist.

It will probably be possible to use standard software packages for sorting, filing, matching, updating and checking operations. Standard data analysis software packages (which could be applied to generate manpower trend data, the results of mobility algorithms and other Targeting System information outputs) could also be used with limited revision. However, software development will be necessary to develop some of the Targeting System's algorithms.

Some amount of computer systems design work will be necessary to coordinate and install the software elements required by the Targeting System. In addition, a standard computer system security procedure for maintaining the privacy of the individual (both employer and employee) would need to be selected and revised to meet the special requirements of the Targeting System.

In order to avoid overloading the Occupational Education Study Group, sensible output formats need to be developed so that only significant information is reported.

D. Targeting System Information Outputs. Files and Measures

The purpose of this Section is to show how Targeting System information outputs are obtained from the Targeting System data base, and to define measures for the quantities discussed in Section II (e.g., job relatedness, educational mobility). The discussion focuses on quantities which are "building blocks" for first-level targeting decisions (see Section II A), but mentions some quantities which would be useful for decisions at the second level. Examples of how these quantities might be used to support targeting decisions at the first level appear in the next section of this report.

The discussion in this Section by no means exhausts the possibilities for extracting useful planning information or useful measures from the data base. The discussion is intended to show, by way of concrete examples, how to use the data base, and to serve as a foundation for the discussion of first-level targeting decisions in Section III E.

1. Files

All of the files described below (except the first) are longitudinal files: they contain information obtained during several successive years. Therefore, trends can be identified from these data.

a. Zip code file

A file can be constructed which identifies the zip codes which fall within the boundaries of each educational

service region. Since the data base contains the addresses (including zip codes) of all workers and employers, this file would enable workers and employers to be located within educational service regions.

Some zip code areas will not fall entirely within the boundaries of an educational service region. These "fringe effects" are not expected to have a significant impact on calculations which use this file. Overlapping zip code areas could be either excluded from or included in the service region, and calculations performed separately for each case to see if the results vary significantly. If greater precision is required, street addresses could be employed instead of zip codes, but at considerably greater expense.

b. Income-by-occupation file

A file which relates occupations to the educational level and skills required for these occupations can be constructed from information contained in the DOT. Since the educational level and skills required by different occupations are correlated with income, a ranking of occupations by skills could be used to divide incomes into meaningful intervals (e.g., less than $2,999/yr., 3,000-4,999, 5,000-7,999, etc.). From this ranking, an income-by-occupation file can be constructed. This file would be of use in calculating the mobility of the population within different occupations.

The file could be adjusted to reflect the

boundaries between socioeconomic classes, and thereby be used to pick up information concerning particular groups as they are defined in law (e.g., the disadvantaged).

c. Regional occupations file

This file will identify the workers in each occupational (DOT) category within each region. It is constructed by applying the zip code file to the computerized data base. The number and proportion of workers in each category can be determined from this file.

d. Regional occupations-by-employers file

This file will contain the number and proportion of jobs in each occupational (DOT) category for each employer within a region. This file can be used in the construction of an index to measure the relative regional stability of each occupational category. The index would allow a determination of the likelihood that jobs in particular categories would continue to be available if a particular employer left a region.

e. Industrial staffing patterns file

This file will contain the proportions of workers in each occupational (DOT) category which are characteristic of different industries (e.g., steel, computer manufacturing). These proportions can be computed for all industries, for industries within each Standard Industrial Classifications, or for individual industries within all or selected regions.

2. Measures

a. A measure of current regional manpower needs

The number of employment opportunities (NEO) which occur within a region, for a particular occupation or occupational cluster and during a specified period of time ending in the current year, can be taken as a measure of the current regional need for manpower in that occupation or occupational cluster. Since the computerized data base is obtained from tax returns which are submitted annually, the period of time specified for calculating NEO must be at least one year. Two or more years may be a more suitable period for certain occupations and under certain circumstances.

The number of employment opportunities is made up of two parts: job market growth (or contraction), and job turnover. These quantities are defined as follows:

(1) Job market growth. The change in the number of positions for a particular occupational category within the specified region and during the specified time interval. This quantity can be determined from the occupations-by-employers file;

(2) Job market turnover. The number of workers in the specified region who have changed jobs within the same occupational category during the specified time interval, plus the change in the number of workers in the occupational category and in the region due to death, disability and

migration during the specified time interval. These quantities can be determined from the regional occupations file.

The NEO is then determined as follows:

NEO = [job market growth (or contraction)] + [job turnover].

The NEO, like any other estimate, can be corrected for a variety of factors.

b. Measures of future regional manpower needs

The information contained in the industrial staffing patterns file can be examined over a period of several years, and time-series statistics applied to these data to detect significant regional trends. Similar analyses can be performed using data on regional job market growth within various occupational categories. When these trends are suitably combined with pertinent information and intelligence concerning anticipated regional economic changes, industry movements, and similar expected developments (see Fig. 1), regional manpower projections for different occupational categories can be constructed. These projections can be expressed in terms of expected changes in the NEO for different occupational categories.

As Figure 1 indicates, algorithms can be developed to permit future regional manpower needs to be estimated

on a digital computer. The algorithms will be developed empirically.

c. Measures of mobility

(1) Induced mobility

A measure of the induced mobility of graduates of occupational education programs can be constructed as follows:

Step 1. For a specific occupational program and a specific region, a sample of the program's graduates would be drawn from the data base of the Occupational Education Reporting and Evaluation System. Each graduate in the sample would be identified by his social security number.

Step 2. The occupations completely overlapping the training received in this program would be identified and the DOT job code for these occupations would be recorded (see the discussion of job relatedness in Section III D 2d).

Step 3. In a subsequent year, when the graduates of the program may be assumed to have found jobs, each graduate in the sample would be located in the Targeting System data base by means of his social security number. The DOT job code apppli-cable to the job actually held by the graduate would be recorded.

Step 4. For graduates whose DOT job code conforms with the DOT codes recorded in Step 2, the region in which the graduates' employer is located would be determined from his employer's zip code using the Zip Code file. For each such graduate

working in the region where he received his training, a "zero" would be recorded. For each such graduate working in some other region, a "one" would be recorded.

Step 5. A measure of the induced mobility of the program's graduates would be obtained by expressing the total number of "ones" as a fraction of the total number of "ones" plus the total number of "zeros".

Induced mobilities for specific regions to which program graduates are migrating could be similarly calculated, as well as induced mobilities for occupations having varying degrees of overlap with the training received in the program. Finally, the induced mobility of program graduates can be calculated without specifying what types of jobs they hold.

(2) Social immobility

On the hypothesis that the Occupational Education Reporting and Evaluation System data base contains such student information as race, ethnicity, family size, family socioeconomic status, number of close friends in the region, and so on, an appropriate measure of social immobility might be constructed by combining these factors into a linear expression using different weighting coefficients for each factor. If the regions in which the occupational students have found employment were examined for several years subsequent to their graduation (using the Targeting System's data base),

it would be possible to identify immobile segments of regional populations and to determine if such a linear combination predicts social immobility for particular, empirically-determined values of the weighting coefficients.

(3) Occupational mobility

While measures of occupational mobility are not required for targeting decisions (see Section II E), such measures could be useful to regional administrators in occupational education for other purposes. For example, it would be useful to have some regional estimate of the attrition of students taking occupational programs at the secondary level. This attrition is likely to be strongly dependent on the occupational mobility of the students' parents. Occupational mobility indices would be useful in estimating the number of students who will withdraw from occupational programs during the school year because their parents leave the region.

A measure of occupational mobility can be constructed as follows:

Step 1. For a particular tax year, draw a sample of workers with dependent children from the Targeting System computerized data base. This sample would be stratified by income: the number of workers drawn at random from each income bracket would be proportional to the total number of persons in that income bracket in the labor force of New York State.

Step 2. Determine the work-site zip codes of the persons in

the sample population.

Step 3. For a subsequent tax year (say five years later) locate the same persons in the Targeting System data base, and again determine the work site zip codes for each member of the sample population.

Step 4. Compare work site zip codes for the two tax years. If they agree, record a "zero". If they are different, record a "one".

Step 5. For each income bracket, the mobility can be determined by expressing the total number of "ones" as a fraction of the total number of "ones" plus the total number of "zeros".

Step 6. Use the Income-by-Occupation file to relate occupations to income brackets and thus determine occupational mobilities.

If desired, occupational mobilities for different regions can be calculated by partitioning the sample by region prior to Step 3 (using the Zip Code file), and then performing Steps 3 through 6 separately for members of the sample population working initially in different regions.

d. Measures of system effectiveness

(1) Job relatedness

A measure of the relatedness of occupational training to the jobs actually held by occupational graduates can be obtained by locating all of the graduates of a particular occupational program in the Targeting System data

base, recording the occupational (DOT) designation for their jobs, and then determining what proportions of graduates hold jobs that are related in varying degrees to their occupational training.

Figure 2 shows hypothetical results for this type of analysis. The degree of job similarity (or overlap) between graduates' jobs and their occupational training is plotted on the horizontal axis. Job similarity is defined as the degree of overlap between the entry level skills of the graduates' jobs and the entry level skills of the occupational cluster for which the graduates were trained in their occupational education programs. The measure of job relatedness is the proportion of graduates whose jobs strongly overlap the occupational cluster for which they were trained. The number of different jobs which are judged to be "strongly overlapping" may be different for different programs.

Several procedures may be used to determine the degree of overlap between graduates' training and the entry level skill requirements of the jobs held by graduates. A gross determination may be made using the Dictionary of Occupational Titles (DOT). Jobs falling within the same DOT group, category, and division as the occupation for which the graduate was trained would be considered completely overlapping. Occupations falling within the same division and category but within a different group would be considered

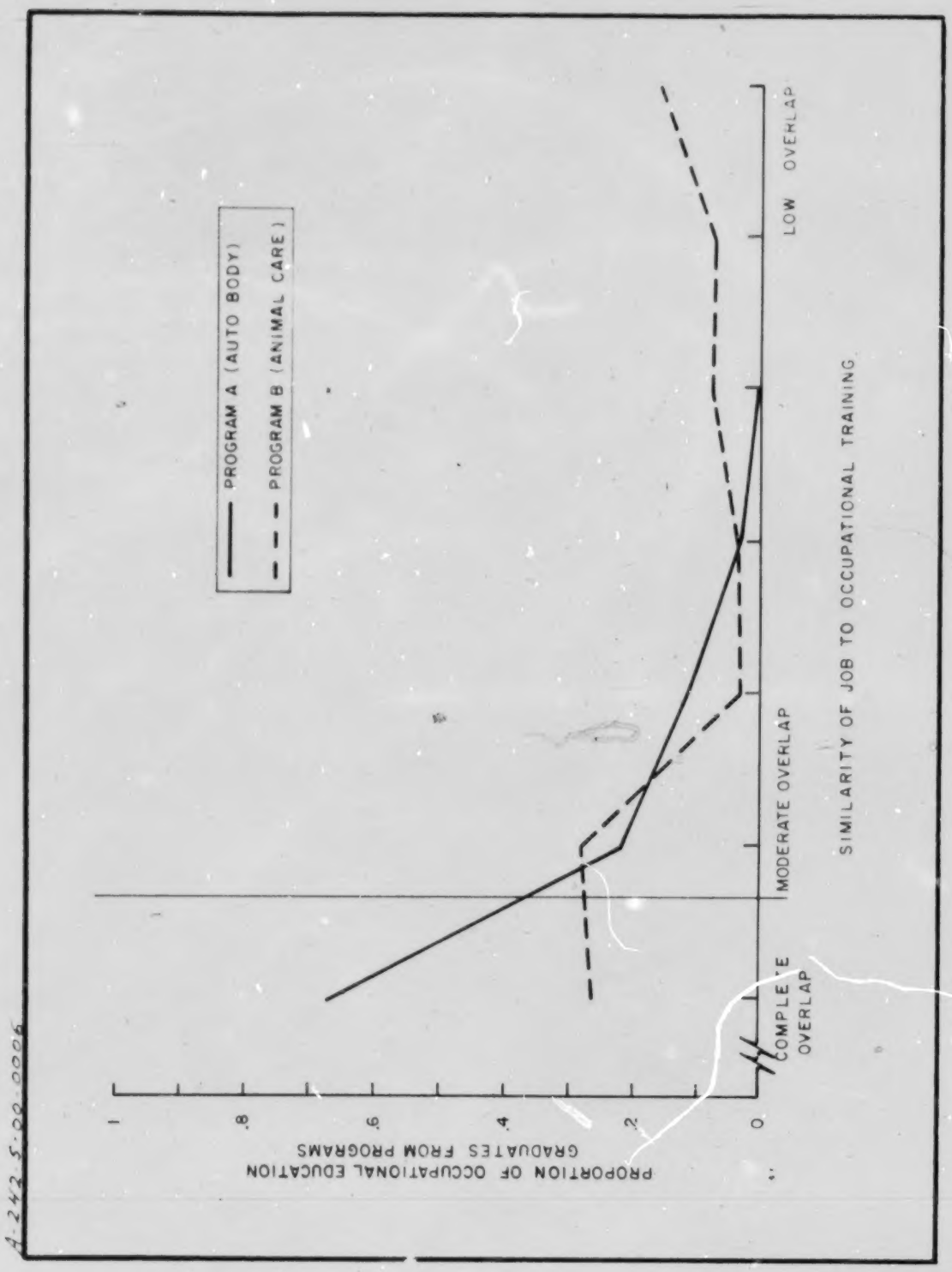

FIG.2 MEASUREMENTS OF JOB-RELATEDNESS

moderately overlapping. Jobs falling outside of both the group and category but within the same division would be described as having low overlap.

A better procedure for determining the degree of overlap would involve a direct assessment of the similarity of the entry level skills required for different jobs. Job analysts (preferably those who developed the DOT) would be asked to judge the similarity in entry level skills between all pairs of job groups in the DOT which are relevant to occupational education. The analysts would assign a number to each job pair to indicate the degree of similarity.* The similarity judgments would then be subjected to hierarchical cluster analysis in order to obtain a valid determination of the overlap.

In Figure 2, the proportions of occupational graduates employed in different job categories are plotted as a function of the degree of overlap (from complete to moderate to low) between their job categories and the occupations for which they were trained. Hypothetical data is shown for two programs: auto body; and animal care. For

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* RRI's interviews with DOT analysts and reviews of analyst training procedures indicate that similarity judgments provided by groups of analysts would be both valid and reliable.

program A (auto body), the proportion of graduates with complete overlap is approximately 0.7. For program B (animal care), the proportion is less than 0.3. Inspection of Figure 2 indicates that a large proportion of graduates of the auto body program are employed in the job cluster for which they were trained (high job relatedness), and that a smaller proportion of graduates of the animal care program are pursuing training-related employment (moderate job relatedness).

(2) Penetration

A measure of the penetration of the regional job market by graduates of occupational programs holding jobs strongly related to their training may be constructed as follows:

Step 1. For a specific occupational program and a specific region, students who graduated from the program during the previous year (or several years ago, if appropriate) would be identified in the Occupational Education Reporting and Evaluation System data base. Each graduate would be identified by his social security number.

Step 2. The occupations which completely overlap the training received in this program would be identified and the DOT job code for these occupations would be recorded.

Step 3. The graduates would be located in the Targeting System Data base for the current year using the graduates' social security number. The DOT job code applicable to the job

actually held by each graduate would be recorded.

Step 4. The number of graduates employed in the region whose DOT job code conforms with the DOT codes recorded in Step 2 would be determined.

Step 5. A measure of penetration would be obtained by taking the ratio of the number of graduates calculated in Step 5, to the NEO for the occupational cluster defined in Step 2 and for the period of time chosen in Step 1. Thus:

$$\text{Penetration} = \frac{\left[\begin{array}{l}\text{occupational graduates in region} \\ \text{holding training-related jobs} \\ \text{(complete overlap)}\end{array}\right]}{\left[\begin{array}{l}\text{NEO in region for the appropriate} \\ \text{occupational cluster}\end{array}\right]}$$

Penetration can also be calculated for different degrees of job similarity. The procedure is the same, except that the DOT job codes recorded in Step 2 would be those for moderate or low overlap. Penetration indices for moderate and low degrees of overlap would be useful for second-level decisions of the kind discussed in Section II.

Inter-regional penetrations (see Section II D 1b) can also be calculated using the procedure just described. Inter-regional penetration can be defined as:

$$\text{Inter-regional Penetration} = \frac{\left[\begin{array}{l}\text{occupational graduates from region} \\ \text{A holding training-related jobs in} \\ \text{region B (complete overlap)}\end{array}\right]}{\left[\begin{array}{l}\text{NEO in region B for the appropriate} \\ \text{occupational cluster}\end{array}\right]}$$

e. An example of Targeting System information outputs

An example of how some Targeting System output measures might be presented is shown in Table 2. A hypothetical auto body program given in a particular region has been chosen for this example. The rows describe job similarity, or different degrees of overlap, between the program and the jobs held by the graduates. The number of graduates holding jobs of varying similarity to their training is entered in each row, and the corresponding percentage is also shown.

In the right-hand columns of Table 3, the current regional need for manpower in the auto body field is shown for each degree of job similarity. The need is shown both in absolute terms (NEO) and in terms of a comparison of current NEO with NEO from an earlier base period. The comparison provides a rough indication of growth.

The third column measures the penetration of auto body graduates into the labor market for each degree of job similarity. Thus, the 50 graduates who are working at jobs for which they were explicitly trained indicates that the program is moderately job related (job relatedness = 0.5), and that a penetration of 0.05, or 5% of the job market (50/1,000 = 0.05) has been established by the graduates. In turn, the NEO of 1,000 represents a current regional need for auto body specialists which is not being met by the graduates of the program.

Table 2

Targeting System Output Measures for a Hypothetical Region and for a Hypothetical "Auto Body" Program

Similarity of Program to Job (overlap)	Number of Auto Body Program Graduates (197_) Number	%	Occupational Education Penetration†	Current Manpower Need (NEO)	Job Market Growth High, Mod, Low, Zero, Neg
Complete	50	50	.05	1,000	X
High	35	35	.01	3,000	X
Moderate	10	10	.005	2,000	X
Low	4	4	.02	200	X
None	—	—	—	—	
Not Found	4	1	N/A*	N/A*	
Total:	103	100%			

†for this example, it is assumed that all of the program's graduates are still in the region.

*not applicable.

E. Using Information Outputs for First-level Targeting Decisions: Some Examples

The purpose of this section is to illustrate how the measures defined in the previous section might be used to support first-level targeting decisions. First-level targeting decisions were defined (in Section II A) to be decisions related to specific occupational programs offered in a particular region.

A hypothetical first-level decision tree for a specific occupational program (labelled X) in a particular region (labelled A) is shown in Figures 3 and 4. (Each Figure contains part of the tree. The figures appear on pages 76 and 77.) Each of the thirteen tracks shown in the figures presents the Occupational Education Study Group with one or more options, or possible courses of action, which are consistent with the measurements carried out in the construction of the tree.

The set of options shown at the bottom of each track is not intended to be complete. The decision tree shown in the figures is given as an example of how Targeting System information outputs can be applied to first-level targeting decisions, and is not intended to be definitive. For example, special circumstances may exist in particular regions which should be considered by the Study Group and taken into account in choosing among possible courses of action. In practice, the measurements and logical operations used to construct the decision tree would be carried

out on a digital computer and the results (accompanied by appropriate computer-generated documentation) presented to the Study Group for evaluation (see Figure 1).

1. Using measures to reduce uncertainty

Three measurements are used to characterize the status of the graduates of occupational program X and to reduce the uncertainty associated with the selection of a course of action which may improve that status.

The measurement of job relatedness determines the proportion of the graduates of program X holding training-related jobs in all regions. If job-relatedness is low, occupational program X could be of low quality. On the other hand, low job-relatedness could mean that the number of training-related job openings is low, and that the graduates of program X are being compelled to take jobs weakly related to their training in order to secure employment.

This type of uncertainty can be reduced by examining the degree to which the graduates of program X are penetrating the market for strongly-related jobs (i.e., jobs in occupational category X) in region A. If program X is of low quality, penetration should be low. If the number of training-related job openings is small, penetration should be high.*

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* In all cases, special circumstances in region A may require modification of these conclusions. A complete discussion of such modifications is outside the scope of this discussion.

If job-relatedness is high, a measurement of induced mobility can further reduce uncertainty. For example, high job-relatedness and high penetration indicate that graduates of program A are finding training-related jobs and filling the regional manpower need for workers in occupational category X. There is still a question of whether or not to expand the program. A measurement of induced mobility will determine whether graduates of program X are migrating to contiguous regions to take training-related jobs. If induced mobility is high, expansion of the program may be justified. If induced mobility is low, the program should probably be maintained as it is.

If job-relatedness is low, only a small proportion of the program's graduates are finding training related jobs in all regions. In this case, the major uncertainty is associated with why job relatedness is low, and measurements of induced mobility will not help to reduce this uncertainty.

In order to proceed down the decision tree, criteria must be established to determine when the values obtained from the measurements indicated on the figures are to be judged as high or low. In practice, these criteria will vary from region to region, and will have to be determined for each program from such factors as the region's occupational profile, the regional economy and the employment experiences of the program's graduates. In addition, it may be desirable to divide the range of measured values into more than two intervals (e.g., very high, high,

moderate, low, and very low, rather than just high and low), a procedure which would result in many more tracks and would unnecessarily complicate this example. In any case, the criteria and number of intervals chosen in practice for each program and region will be reviewed periodically in the light of Targeting System performance and adjusted if necessary.

2. Discussion of the figures

In each figure the decision tree begins with an assessment of the current regional manpower need in occupational category X. This current need is measured by the number of employment opportunities (NEO). An estimate of future regional manpower need is made to determine whether the NEO is expected to increase or decrease.*

Since this example is entirely concerned with first-level decisions, all measurements of the NEO, job-relatedness, penetration and induced mobility refer to the cluster of occupations which have complete overlap with program X (see Section III D 2d).

The Figures will now be discussed separately.

Figure 3.

Figure 3 shows the set of tracks corresponding to an increasing need for regional manpower in occupational

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* Decisions may also be influenced by the expected rate of increase or decrease in the NEO. The effects on decisions of the rate of change of the NEO have not been considered in all cases.

category X (increasing NEO).

Track 1. The increasing NEO probably calls for the introduction of program X into the region. In choosing between a large or small program, the magnitude of the current NEO and the expected rate of increase of the NEO should be considered. The Targeting System can provide additional information which may be helpful, such as the rate at which workers in occupation X are migrating into or out of the region. Measurements of inter-regional penetration would also be useful to determine the extent to which occupational graduates (of programs equivalent to program X but offered in surrounding regions) are already filling the manpower need in region A.

Tracks 2 and 3. Note how the measurement of induced mobility is used to time the expansion of this successful program. In track 2, program graduates are finding training-related jobs in region A as well as in contiguous regions. Expansion of the program should be as fast as possible consistent with keeping job-relatedness high. (If job-relatedness falls, go to track 6.)

In track 3, graduates of the program are meeting regional manpower requirements in region A only. The rate of increase of the NEO will govern the expansion of the program, but a decline in penetration would be a sensitive indicator that the time to begin expansion had arrived. (If penetration falls, go to track 5.)

Track 4. In this case, the majority of the graduates of program X are finding training-related jobs outside of region A. Regional factors, such as union hiring restrictions, regional wage scales and local living conditions, should be checked to establish the reason. If these local conditions can be rectified, penetration should rise sharply. (If penetration rises, go to track 3, because induced mobility should drop if the number of graduates remains the same.) If the local conditions cannot be rectified, the program should be matched to the manpower needs of the regions to which the graduates are migrating.

Track 5. The program is probably of high quality, but producing too few graduates to meet regional needs. The program should be expanded rapidly until penetration rises. (When penetration becomes high, go to track 3.)

Track 6. High penetration indicates that the program is probably of good quality, but that too many graduates are being produced. What to do in response to this situation depends on the rate at which the NEO is increasing. If the NEO is increasing slowly, option 1 may be a sensible course of action to follow. If the NEO is increasing rapidly, increasing need for manpower may rectify the situation before any contraction of the program could become effective (option 2: no action).

In either case, if the program is effective, job relatedness should rise as the program is contracted or the NEO rises or both. However, if job relatedness remains low and penetration begins to fall off, the program needs adjustment to improve its quality (see track 7).

Track 7. The program is probably ineffective and requires rapid adjustment because of the increasing NEO. The important requirement is to improve job relatedness. The three parts of option 1 address the problem of low job relatedness and can be performed sequentially or simultaneously. "Other factors" refer to such circumstances as union hiring restrictions or racial attitudes which may exist in the region and restrict the ability of graduates to obtain training-related jobs.

The employer survey referred to in part b of option 1 could be executed as follows:

- Draw a sample of regional employers stratified by size from the occupations-by-employers file;
- Ask employers in the sample to list the skills they require for the job in question, and to rank them in order of importance;
- Determine the correlation between the number and ranking of skills furnished by the employers, and the number and ranking of skills specified for the program;

- Adjust the program content to increase the correlation between the program and the specifications furnished by the employers.

Figure 4

Figure 4 shows the set of tasks corresponding to a declining need for regional manpower in occupational category X (declining NEO).

Track 8. Since the NEO is declining, the introduction of a program may not be a good idea. Special circumstances in the region may have a large effect on the decision. If a program is introduced, the justification for introducing it would be stronger if induced mobility could be expected to be shown by the program's graduates, and if there was a large or expanding need for manpower in occupational category X within surrounding regions. This case illustrates the utility of having a measure of social immobility to characterize the likelihood that graduates of a specified regional program will show induced mobility.

Tracks 9 and 10. The measurement of induced mobility can be used to time the contraction of the successful program in the face of a declining NEO. In track 9, high induced mobility may offset the declining NEO in region A and, if future manpower needs are high in contiguous regions, may justify an expansion of the program. In either track, a fall in job relatedness will signal the need to contract the program.

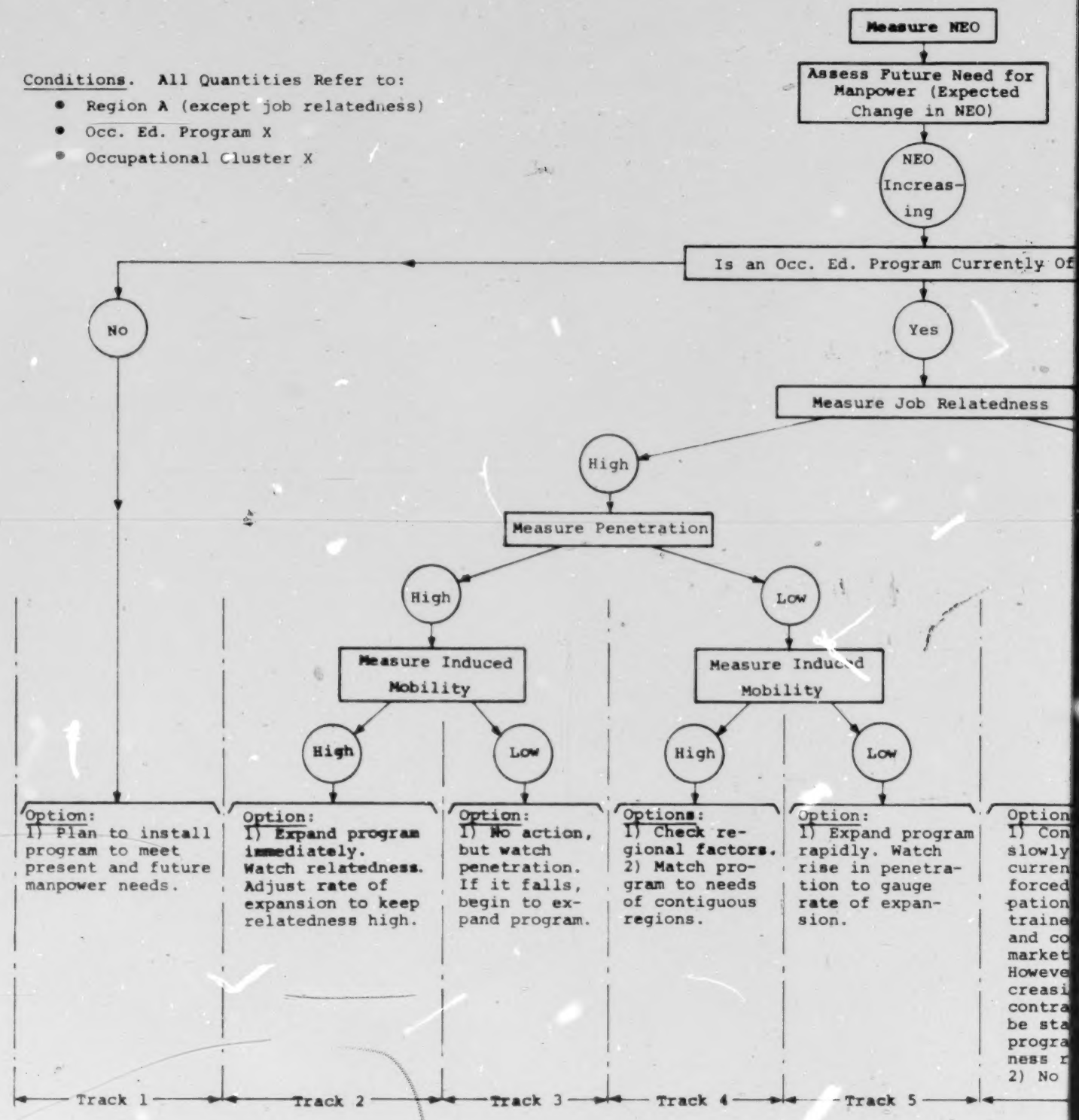
Track 11. In this case, as in track 4, the majority of the graduates of program X are finding training-related jobs outside of region A. Regional factors, such as union hiring restrictions, regional wage scales and local living conditions, should be checked to establish the reason. If these local conditions can be rectified, penetration should rise sharply. (If penetration rises, go to track 10, because induced mobility should drop if the number of graduates remains the same.) If the local conditions cannot be rectified, the program should be matched to the manpower needs of the regions to which the graduates are migrating.

Track 12. The program is probably effective and is currently producing too few graduates to meet regional job market requirements in occupational category X. However, the NEO is declining. If the NEO is declining rapidly, option 1 may represent a suitable course of action. If the NEO is declining slowly, a small expansion of the program (option 2) may be more appropriate to satisfy the current manpower need. In either case penetration should be watched. (If penetration rises, go to track 10.)

Track 13. As in track 6, high penetration indicates that the program is probably of good quality but that too many graduates are being produced. Since the NEO is declining, rapid contraction of the program may be called for. Contraction should be rapid enough to produce a rise in job relatedness.

Track 14. This appears to be an ineffective program in a declining job market. If the NEO is declining slowly, it may be worthwhile to evaluate the program and to adjust it if program objectives are not being met. An improved program could be of interest to students in the region who wish to enter occupation X. However, if the NEO is declining rapidly, the program should probably be phased out. In either case, special regional circumstance may have a large effect on the decision.

For all Targeting System processes, the computer would furnish documentation to support the first-level decisions adopted by the Study Group, and to provide input data for second-level decision making processes.


Conditions. All Quantities Refer to:
• Region A (except job relatedness)
• Occ. Ed. Program X
• Occupational Cluster X
Measure NEO
Assess Future Need for Manpower (Expected Change in NEO)
NEO Increas-ing
Is an Occ. Ed. Program Currently Of
No
Yes
Measure Job Relatedness
High
Measure Penetration
High
Low
Measure Induced Mobility
Measure Induced Mobility
High
Low
High
Low
Option: 1) Plan to install program to meet present and future manpower needs.
Option: 1) Expand program immediately. Watch relatedness. Adjust rate of expansion to keep relatedness high.
Option: 1) No action, but watch penetration. If it falls, begin to ex-pand program.
Options: 1) Check re-gional factors. 2) Match pro-gram to needs of contiguous regions.
Option: 1) Expand program rapidly. Watch rise in penetra-tion to gauge rate of expan-sion.
Option 1) Con slowly curren forced pation traine and co market Howeve creasi contra be sta progra ness r 2) No
Track 1
Track 2
Track 3
Track 4
Track 5

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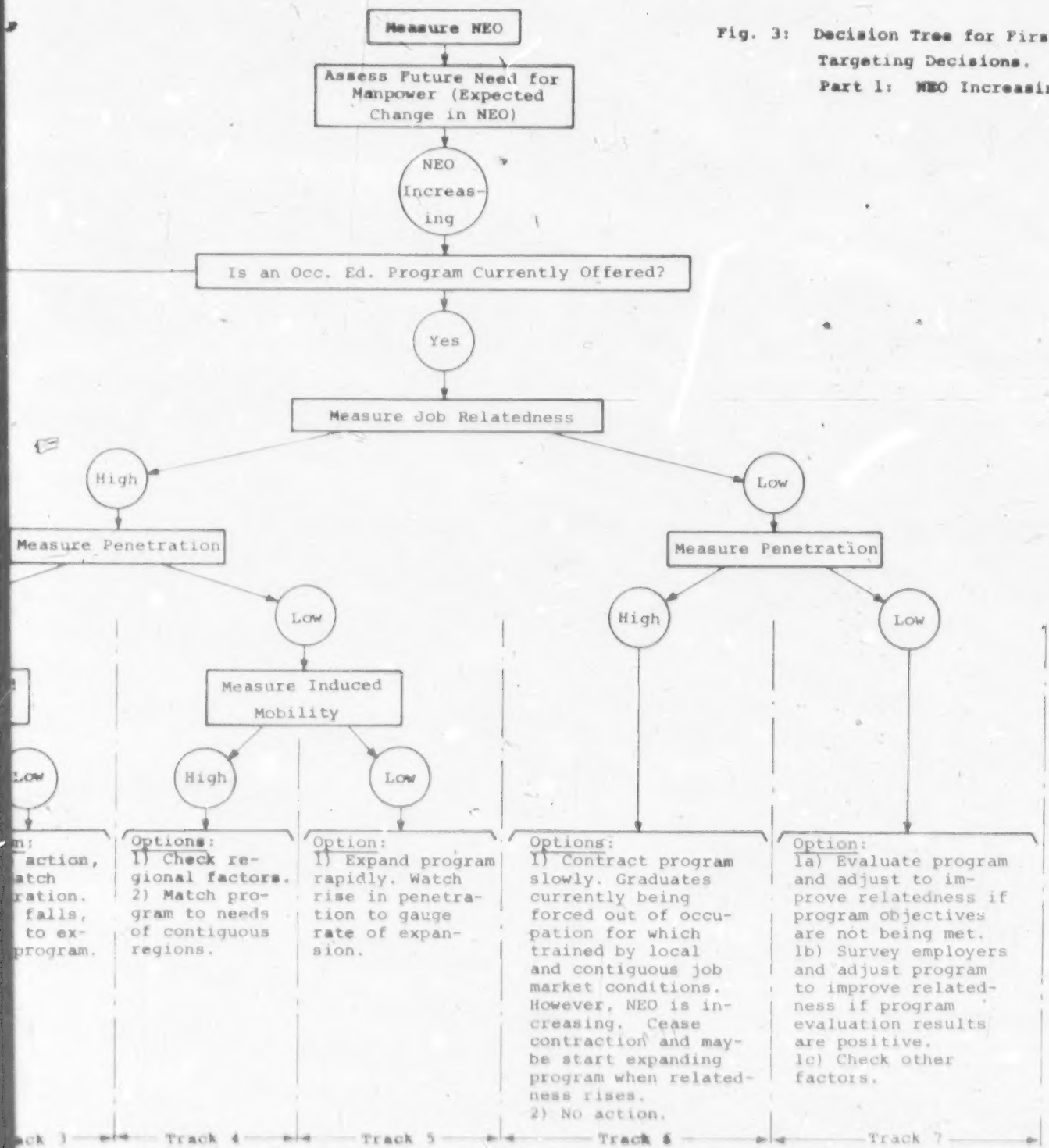
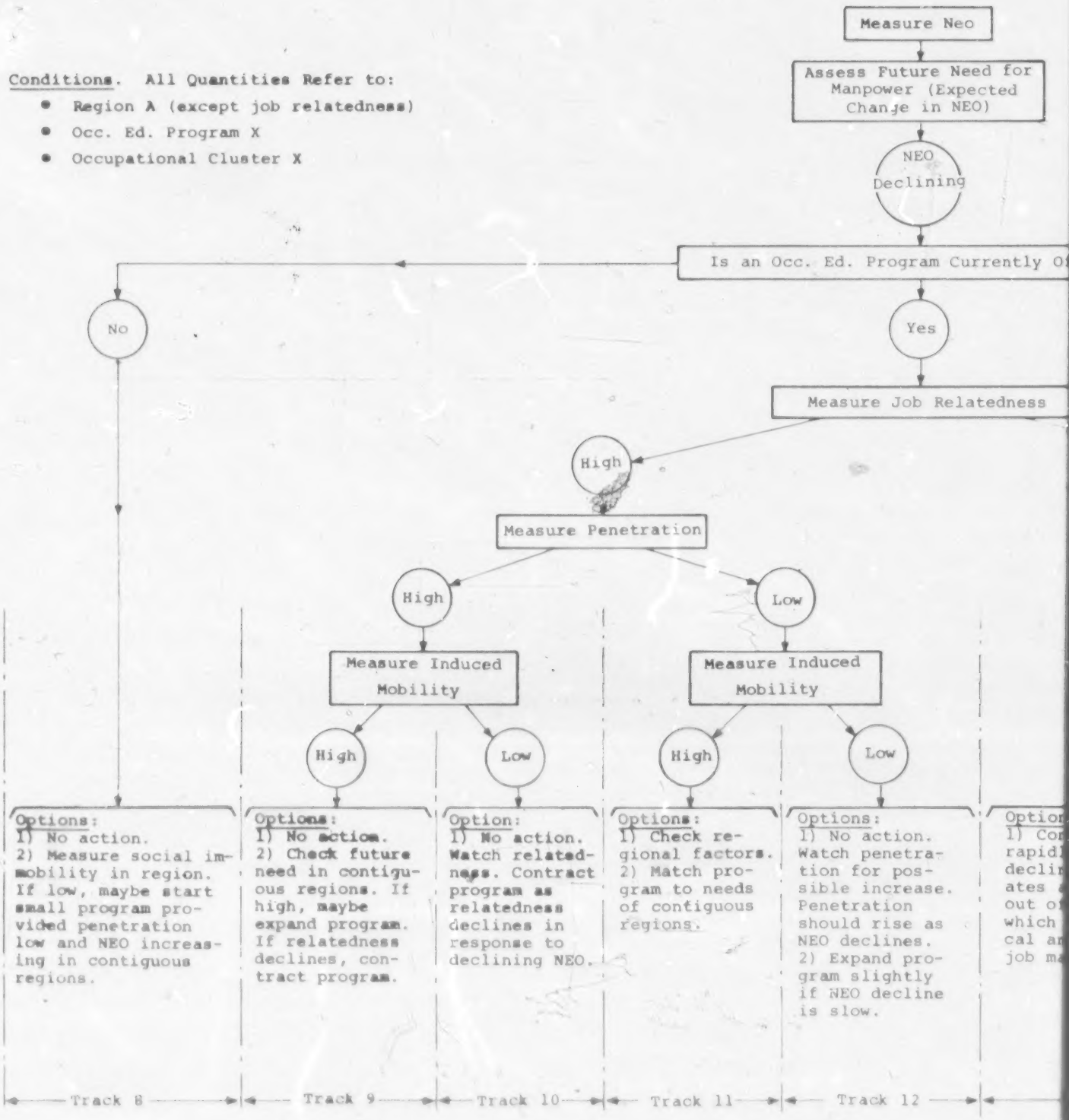

Measure NEO
Assess Future Need for Manpower (Expected Change in NEO)
NEO Increas-ing
Is an Occ. Ed. Program Currently Offered?
Yes
Measure Job Relatedness
High
Low
Measure Penetration
Measure Penetration
Low
High
Low
Measure Induced Mobility
High
Low
Options:
1) Check regional factors.
2) Match program to needs of contiguous regions.
Option:
1) Expand program rapidly. Watch rise in penetration to gauge rate of expansion.
Options:
1) Contract program slowly. Graduates currently being forced out of occupation for which trained by local and contiguous job market conditions. However, NEO is increasing. Cease contraction and maybe start expanding program when relatedness rises.
2) No action.
Option:
1a) Evaluate program and adjust to improve relatedness if program objectives are not being met.
1b) Survey employers and adjust program to improve relatedness if program evaluation results are positive.
1c) Check other factors.
Track 4
Track 5
Track 6
Track 7

Fig. 3: Decision Tree for First-Level Targeting Decisions.
Part 1: NEO Increasing


Conditions. All Quantities Refer to:
• Region A (except job relatedness)
• Occ. Ed. Program X
• Occupational Cluster X
Measure Neo
Assess Future Need for Manpower (Expected Change in NEO)
NEO Declining
Is an Occ. Ed. Program Currently O
No
Yes
Measure Job Relatedness
High
Measure Penetration
High
Low
Measure Induced Mobility
Measure Induced Mobility
High
Low
High
Low
Options:
1) No action.
2) Measure social immobility in region. If low, maybe start small program provided penetration low and NEO increasing in contiguous regions.
Options:
1) No action.
2) Check future need in contiguous regions. If high, maybe expand program. If relatedness declines, contract program.
Option:
1) No action. Watch relatedness. Contract program as relatedness declines in response to declining NEO.
Options:
1) Check regional factors.
2) Match program to needs of contiguous regions.
Options:
1) No action. Watch penetration for possible increase. Penetration should rise as NEO declines.
2) Expand program slightly if NEO decline is slow.
Option
1) Co
rapidl
declin
ates
out o
which
cal ar
job ma
Track 8
Track 9
Track 10
Track 11
Track 12

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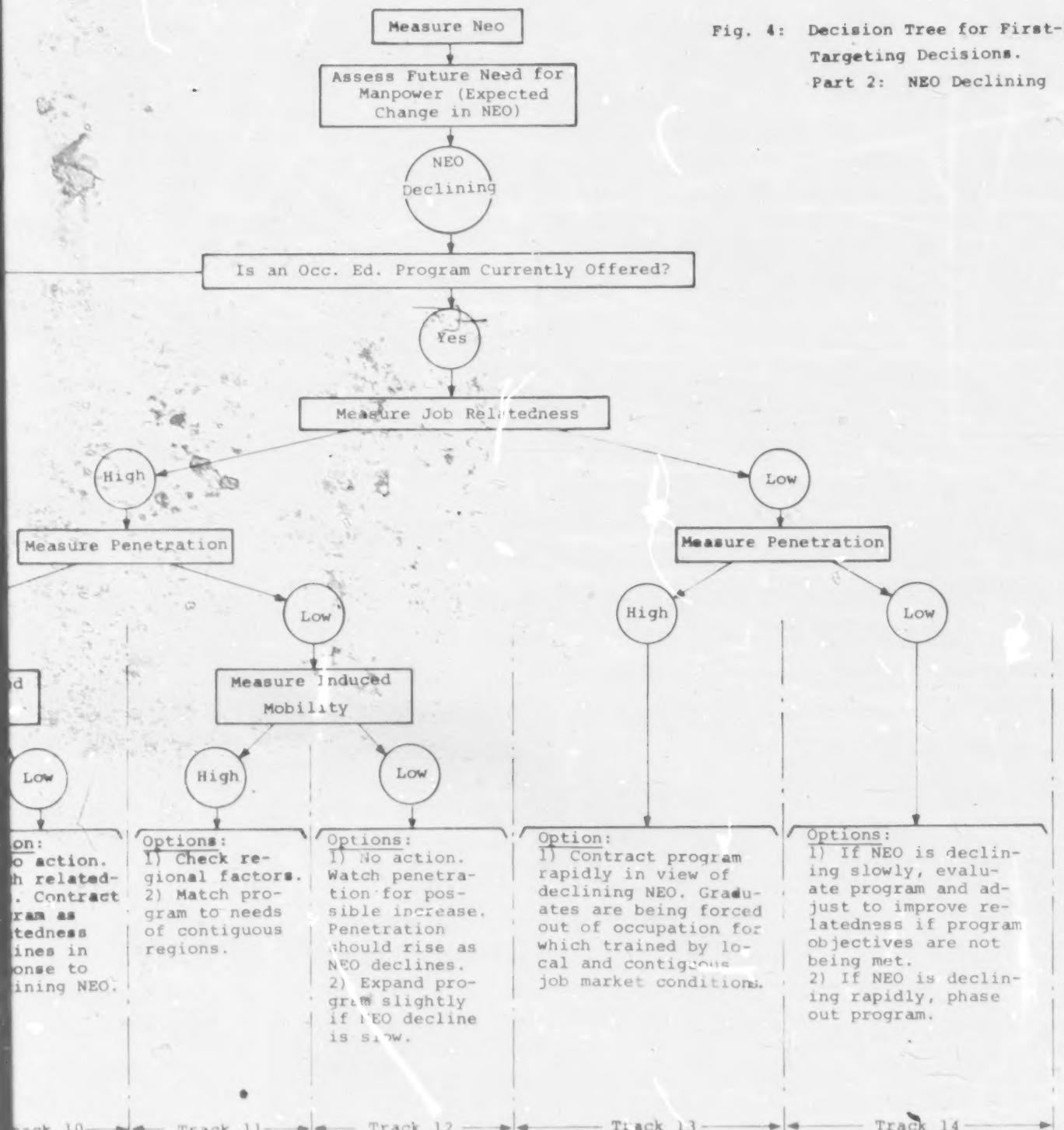

Fig. 4: Decision Tree for First-Level Targeting Decisions.
Part 2: NEO Declining

F. A Brief Look at Further System Design Tasks

1. First-level design tasks

The detailed design of the first-level decision structure must be completed. The completion of the first-level decision structure will require:

- A determination of all educational service regions to be used for occupational education planning;
- A study of manpower needs and occupational factors for each region in order to determine appropriate criteria and numerical intervals for all measures required for first-level targeting decisions;
- The detailing of first-level decision trees and the development of programs to execute first-level decision trees on a computer;
- The specification of processes which the Occupational Education Study Group will use to evaluate the options presented to them by the Targeting System;
- The specification of relevant options corresponding to each track of the decision trees, and the specification of the output formats and documentation which the Study Group will find most useful in carrying out its work.

2. Second-level design tasks

Second-level decisions have been defined in Section II A to be decisions involving the number and variety of occupational programs to be offered within an educational service region. This level of the decision structure takes account of budgetary constraints which may limit the number of regional occupational program offerings. Trade-off analyses which must be made among different candidate programs because of budgetary constraints are performed at this level, according to such criteria as the importance of different occupations to the regional economy, the degree of job-relatedness of current offerings to occupations for which a manpower need exists but for which there is no program offered, and so on.

In addition to being presented to the Study Group for evaluation, first-level decision options, with supporting documentation, serve as input data for second-level decisions. The output of the second-level decision structure is a documented set of alternative regional program plans for occupational education, and a set of recommendations for adjusting particular regional occupational programs. The second-level decision structure will require:

- The specification of all input information required to perform trade-off analyses and other second-level processes;

- The development of trade-off criteria, trade-off algorithms, and second-level decision trees;
- The development of programs to execute second-level decision trees on a computer;
- The specification of output formats and documentation for occupational education regional program plans and for the recommendations to be submitted to the SED Policy Group.

3. Third-level design tasks

A design study will be required to establish third-level design specifications. This design study will address:

- State-wide manpower and industrial growth objectives;
- State budget requirements and constraints;
- The use of Targeting System information outputs and regional occupational program plans to generate the State Plan for the Administration of Occupational Education, and to generate other documentation required by federal and legislative funding sources.

4. Targeting on specific population segments

A design study will be required to determine how the Targeting System should be augmented in order to assist occupational education to enhance its impact on specific segments of the population (e.g., the handicapped, the disadvantaged),

and to determine the educational level (e.g., secondary, post-secondary, adult) at which occupational programs should be offered to coincide best with the needs of the regional populations served.

IV. Other Applications of the Targeting System

A. Student Guidance and Career Decisions

Field investigations conducted by Riverside during the contract period have led to the conclusion that the principal ingredients of guidance counseling in occupational education are student interest and course availability. Little (if any) weight is given to any factors related to the job market.

While a substantial amount of job market information is currently available, it is not easily coordinated with occupational programs, not presented in a manner which renders it relevant for guidance applications, and frequently not applicable to regional job markets. Consequently, this information is commonly ignored. The Targeting System data base could provide regional and statewide manpower information that would be specifically organized for use by guidance personnel. Such information could include employment trends for various occupational categories, induced mobility patterns, and so on.

Guidelines could be developed to help guidance personnel to use this job market information effectively. For example, the guidelines could set forth suggestions and directions for coordinating job market information with regional occupational education course offerings and general education requirements.

The Targeting System could also be used to support guidance processes outside of occupational education. The Targeting

System data base contains information on segments of the population in all professions as well as in all occupations. Because the Targeting System is based upon a highly differentiated occupational coding scheme, has an annual reporting cycle, and can provide regional information, the proposed system would be extremely sensitive to labor market conditions for all professional and occupational groups. Therefore, the System could provide trustworthy information organized to have impact upon the selection of special or advanced training, the selection of a college, the selection of post-graduate training, and other educational decisions.

B. State-Approved Advanced Training

The New York State Education Department currently provides licenses to a variety of commercial schools offering occupational training. These schools frequently advertise that they have State licenses, or approval from the New York State Education Department, or both. Although it may not be feasible to make State licensing contingent upon regional labor market conditions, it might be possible for the State to inform such schools--and their students--of the labor market conditions which apply to the occupational courses being offered. Commercial schools could be encouraged to establish programs in occupational categories in which there is a verified regional need for manpower. The schools could also be discouraged from offering programs in occupations for which there are very limited

employment opportunities.

C. Information for Employers Thinking of Relocating Within New York State

The Targeting System could provide a variety of information to encourage employers to relocate within New York State. Support could also be provided to aid in the selection of an appropriate region. For example, the Targeting System could be used to provide characteristics of regional labor forces, regional salary data for various occupational groups, regional mobility indices, and other useful information.

In addition, the Targeting System's data base could be used to estimate the manpower needs associated with additional services which will be required in a region in which a large employer has decided to relocate. The Targeting System's information sources can be used to determine the present occupational and professional profile of the region. The impact that a new employer of known characteristics will have on regional demands for health and other service personnel can be estimated. From these data, manpower forecasts associated with the needs for additional services can be made and factored into occupational education program planning.

D. Utilization of the Targeting System Data Base by the New York State Labor Department

The Targeting System data base would be far superior in accuracy and stability to the U.S. Census, which is currently the major source of information on which present and future manpower estimates are based. Many of the objectives of the New York State Department of Labor might be better served through use of the more accurate and timely data provided by the Targeting System. For example, special industry studies and employment research could be more easily carried out. In addition, the availability of regional and statewide occupation-by-industry matrices could eliminate the need for "judgmental" analysis and surveys which are currently used to characterize job market conditions.

E. Regional Population Data

The Targeting System data base could be used to provide population densities, summarized salary data, and occupational profiles for arbitrarily defined regions within the State. Such information could be used as a basis for the provision of various public services. Easily obtained demographic information, which can be aggregated in whatever manner is desirable for the project being planned, could be used to determine sites for schools, public housing projects, public Hospitals and other State or local projects.

F. Higher Education

The approach employed in the design of the Targeting System calls for the iteration of program plans based on the results of measurements of system effectiveness (e.g., penetration and job relatedness). The same approach could be employed to target offerings in certain branches of higher education, such as engineering and the sciences, using the present Targeting System data base.

G. State Planning Efforts

The Targeting System's data base could be used as a source of data for studies to determine the regional impact of State projects. For example, studies could be made of regional demographic characteristics and population densities both before and after new housing projects or new transportation systems were constructed. The impact of these projects on the tax structures of surrounding regions could be assessed, and this information related to such indicators as crime rates which are available from other sources.

The ability to execute such studies at low cost and with high precision could be of great importance in reducing the uncertainty surrounding the expected results of alternative courses of action contemplated by the State. Many unforeseen consequences of programs in housing, transportation, health care, ecology, and so on, possibly could be detected if modern

statistical techniques were used to search for pertinent relationships in the Targeting System's data base. Indeed, if the most accurate, complete and current file of information collected by the State government becomes available, the costs associated with applying sophisticated statistical approaches to planning studies could be drastically reduced.

V. Appendix

Existing Methods of Assessing Present and Future Regional Manpower Requirements

A. The Method of Regionalizing Nationwide Manpower Requirements

The Bureau of Labor Statistics (BLS) of the United States Department of Labor publishes census-based, nation-wide projections of manpower requirements. These estimates are given for each occupation on the standard BLS list. The projections are provided for all areas of the economy combined, and for each of nine major categories within the Standard Industrial Classification: agriculture, mining, construction, manufacturing, trade, finance, service, public utilities and government.

Initial gross projections are based upon estimates of the gross national product, civilian employment, and the size of the armed forces. A variety of techniques (e.g., input-output analysis, regression analysis, individual industry studies) and qualitative judgment are combined to refine the nation-wide data (Tomorrow's Manpower Needs, 1969). Major sources of information used in the development of the nation-wide forecasts include occupation-by-industry data available through the Bureau of the Census (e.g., Subject Reports, 1963) as well as a variety of industry and manpower reports availabl

from other federal sources.*

These National Manpower Projections (which reportedly represent the collaborative efforts of several research staffs at BLS, and also reflect consideration of occupational outlook, labor force, industry characteristics, economic growth, technological change, and productivity) frequently serve as the basis for regionalized manpower assessments.

In order to obtain corresponding estimates for state and local regions, various techniques are applied to make regional adjustments in the data. One of the most comprehensive regional adjustments has been carried out by the New York State Department of Labor, and is reported in the Department's Manpower Directions (1968). Labor force, industry, and occupation projections for the entire State and for ten major labor market divisions are presented. For manpower and educational planning, and other purposes, the projections are rearranged into other regional classifications (Manpower Planning by Region, 1970), summarized and interpreted for other State agencies (e.g., Annual Manpower Planning Report, 1970), and supplemented by monthly employment data (e.g.,

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* Other sources of information applied by the Bureau of Labor Statistics include BLS surveys of employers, data collected by various federal regulatory agencies, and manpower studies such as Occupational Employment Patterns for 1960 and 1975, U.S. Dept. of Labor, 1968.

N.Y. State Employment Trends) and special surveys (e.g., Manpower Needs in Health Services, 1969).

The basic assumption on which regionalizations of national projections is based are that state and local occupational patterns, population growth, levels of employment, etc. do not differ substantially from national trends, and that state and local estimates are thus more reliable when made within the context of nationwide economic and technological developments. Several manpower analysts (e.g., Wingeard, 1969) believe that this assumption is sufficiently valid for most states, or that it provides a reasonable basis for subsequent judgmental analyses performed for other states.

The method of regionalizing nationwide manpower requirements has the cost advantage of utilizing published national projections prepared with the extensive resources of the BLS and other federal agencies. In addition, the BLS provides staff support and a variety of other services to state labor departments for the regionalization of national data. However, in consideration of the needs of occupational education, there are some deficiencies associated with the approach employed by BLS for obtaining valid national manpower projections and for applying these projections to obtain regional manpower estimates.

The major source of occupational employment statistics used by the BLS is the U.S. Census. The problems associated

with this data source include general undercount, variable response, misclassification and a variety of other problems typically associated with massive surveys (see Occupational Employment Statistics, BLS RPT. #305).

In addition to data validity problems, the national projections assume stable rates of economic growth, population growth, employment, and technological advancement. Such factors are not always stable during the projection period. They are affected by a variety of events which cannot be foreseen when the projections are initially developed. Recent examples of such events include U.S. Government efforts to reduce inflation, persistently higher-than-normal unemployment rates, and decreasing defense and aerospace expenditures. The resulting economic sluggishness has already invalidated several published long-range projections. The BLS itself warns that the larger the disparity between the assumptions of stable growth rates and actual conditions, the more likely it is that actual national employment levels will differ significantly from the projections.

Another set of problems is encountered when national projections are used for the development of manpower information for states and smaller regions. The national industry-by-occupation mix is not completely reflected within state and local areas. The New York State Department of Labor noted in the Technical Supplement to the Manpower Directions report

that factors such as differing levels of technological advancement for the same industry in different states, or the presence of administrative offices or labs in one region and their absence in another, can cause significant variations of area patterns within an industry. Supplemental area analysis can resolve this problem, but properly executed local surveys are costly.

Finally, after obtaining primary experience with the organization and administration of occupational education in New York State, we concur with Scoville's (1969) opinion that the census data are of limited value to occupational education planners because of the relatively lengthy reporting cycle (once in 10 years), the vagueness of the occupational boundaries in census data, and the manner in which census data are aggregated for manpower projections. These problems in the utilization of census data have direct impact upon the value of manpower projections derived from census data to occupational education planners.

B. The Method of the Employer Survey

A traditional procedure for obtaining labor market information on the local level is to survey area employers for estimations of future manpower requirements. Area employers would appear to be an excellent source of detailed and accurate information, such information could be flexibly compiled for regions of different sizes. However, it has been found that few employers keep records of their current openings, nor can they adequately predict their future needs (Somers, 1968; Conference on Manpower Information for Vocational Education, 1969). Some forecasts are limited to highly skilled jobs and are usually conducted informally by personnel departments, others are based on a combination of sales projections, planned expansion of facilities, and empirically based estimates of replacement needs. Detailed analyses of the results of employer surveys in several cities reveal over- or under-estimations for different occupational categories (Somers, 1968).

In any type of survey work, face-to-face contact yields the most significant and complete results. In attempting to obtain reasonable estimates of manpower requirements from employers, much skilled manpower would be needed for extensive field investigation and for review and analysis of data. This effort is extremely costly and time consuming. Medvin (1967), for example, estimated that a skill survey in a large

city might take 4 to 6 months or more to produce preliminary results and would cost about 100,000 1967 dollars. There are several large cities within New York State, each of which would require periodic surveys to provide the data necessary to keep occupational education targeted. Thus, the survey data resulting from this procedure would not justify the costs incurred in obtaining it.

C. The Method of Persistent Openings

An apparently less expensive method of obtaining estimates of local manpower requirements, (sometimes labeled a short-cut approach), makes use of data on unfilled job openings. These data are available from employment services (Medvin, 1967).

On a quarterly basis, lists of total job openings and job openings which have remained unfilled for thirty days or more are collected. Jobs which are judged to be hard to fill because of low wages or poor working conditions are removed from the list. For each remaining occupation, the number of openings unfilled for 30 days is expressed as a percentage of the total number of openings. These percentages are used to assess current shortages and to estimate long-range manpower needs for each occupation. If the percentage within a given occupation remains high over several quarters (i.e., if there is a high percentage of persistent openings), the occupation is considered manpower short.

The next step is to use the U.S. Dept. of Labor's Occupational Outlook Handbook to check national trends in specific job categories. Finally, a labor market analyst interprets the results in order to determine whether expansion will occur in the occupational categories where there have been persistent openings.

Experimentation with this technique in several large cities outside of New York State has produced mixed results (Medvin, 1969). In addition, persistent openings were extensively analyzed in New York State in the process of assessing employment developments and occupational outlooks for Westchester and Rockland Counties (Annual Manpower Planning Report, FY 1971-1972).

Although this method allows for flexible regionalization in labor market assessment, its utility for occupational education planning is limited. The penetration of employment services is limited and varies by area, industry and occupation. Thus, the sample of "persistent openings" may not always be an unbiased barometer of regional job market expansion. In addition, there are many reasons why openings at employment agencies might persist even when there are no manpower shortages.

Even if this method could be expected to produce valid regional results, it could not be used independently. The method only predicts rapid occupational expansion. It may not be used to assess downward trends in manpower requirements, or even slow job market expansion (which would not necessarily result in persistent openings at employment services).

There may also be a problem with the collection and handling of the huge amounts of data associated with all the

occupational categories relevant to occupational education program offerings. The process could potentially require excessive clerical manipulation, particularly if employment services do not report openings in accord with some standard occupational code.

D. Computer Simulation of an Input-Output Model of the Local Economy.

In this method, data concerning the structure and functioning of the economy are accumulated. These data are then used to build an input-output economic model which includes the inter-industry flows of raw materials, intermediate products, energy and services between sectors of the economy. The model functions dynamically to reveal how input-output changes in one segment of the economy effect changes in other segments.

Given the final demand upon each economic sector of industry within the economy, the model can produce indications of the total outputs required for each economic sector or industry. The assumption is made that employment levels within sectors or industries of the economy are directly related to the output in those sectors or industries. Thus, a knowledge of output leads to a knowledge of projected employment levels. Once projected employment levels within a given industry are known, then an appropriate industry-by-occupation matrix (which details the occupational composition of each industry) may be applied to project employment levels of specific occupations within specific industries.

Although this technique has a solid theoretical foundation, tracing the complex interconnections and degrees of interdependence within an economy are extremely difficult (Hamovitch & Levenson, 1969). The construction of the input-output table requires

that records of inter-industry transactions must be retrieved, compiled, and refined (Leontief, 1965). In addition, because of the enormity of the computations associated with the application of the input-output model, the model must necessarily be simulated on a large digital computer.

Some applications of input-output modeling have been attempted. The U.S. Bureau of Labor Statistics has been engaged in input-output analyses of the national economy and has used this method along with others to make projections of manpower requirements. Watson (1970) undertook the task of developing an input-output model for the State of Oregon. The development of the model took a substantial amount of time and unlimited use of a large-scale digital computer. The results were not completely satisfactory but the inherent flexibility of the model's structure allows for improvement.

The input-output model may be applied to the estimation of regional manpower requirements in two ways. The first approach is to apply regional industry-by-occupation matrices to the industry output and employment level data which are obtained from a national or state level input-output model. However, many of the same assumptions associated with regionalizing BLS national manpower forecasts would have to be made. For example, the economic demand, outputs, and consequent

employment levels for particular segments of the economy at the national or state levels would not necessarily be replicated in the particular industries and within the particular regions which concern occupational educators.

Alternatively, input-output models may be developed for particular regions. However, considerable effort and expense would be required. Corporations using input-output models for a specific industry have been known to spend annually as much as $100,000 and more to generate useful forecasting information (Chambers, Mullick & Smith, 1971). The development of regional forecasting models sufficiently detailed to be useful to occupational education planners would be substantially more expensive and more difficult than the corporate applications which have been reported.

E. The Method of Regression on Indicators

For a specified base time period, the relationships between manpower requirements for particular occupations and various economic indicators are determined. These relationships are expressed as statistical correlations. Once established, the correlations are used to project manpower requirements. The simplest case would involve correlations between a single indicator and employment levels in some group of occupations. For example, during the base period, the total number of monthly railroad freight car loadings might be found to bear a stable positive relationship (i.e., a statistically significant positive correlation) to manpower requirements in a variety of commercial occupations (e.g., the manpower requirements have been found to increase and decrease as freight car loadings increase and decrease). After the correlation is established from the base period, the manpower requirements for the correlated occupations may be predicted from a knowledge of freight car loadings.

Variations of this technique have been used for national projections (Tomorrow's Manpower Needs, 1969). Using a 20 year base period (1947-66), regression equations were developed relating industry employment with different combinations of economic indicators (e.g., real GNP, national rate of unemployment, size of Armed Forces, civilian non-institutional population etc.). Combinations of indicators showing large and statistically stable relationships with industry employment were

selected as the final estimates for some of the occupational categories.

Although the computations associated with the method of regression on indicators are not difficult, the collection of the necessary data can be rather arduous. The method requires the deft selection of economic indicators, or substantial iterative analyses to uncover the "best" combination of indicators for prediction of manpower requirements within specific occupational categories. Although some work has been carried out to establish criteria for the selection of specific economic indicators to be used in projecting manpower requirements in specific occupations (e.g., Taylor, 1965), the selection of appropriate indicators remains problematical.

In addition, there is no reason to suppose that regression equations based upon national or statewide data are going to be useful for regional manpower predictions. Expansion or contraction in national or even statewide manpower requirements within given occupational categories will not necessarily be reflected in the industry of particular regions. Thus, if this method is to be used, it would be necessary to develop regression equations for the regions themselves.

Unfortunately, many of the more productive economic indicators are either unavailable for small regions, or nonsensical when applied to regions. For those indicators which can be used, it is far less likely that linear or near linear

relationships with manpower requirements will be obtained for the base time period. Nonlinear relationships between the indicators and manpower requirements are substantially more difficult to apply for predictive purposes.

Perhaps the most compelling criticism of the method of regression on indicators is that yesterday's correlation does not necessarily express tomorrow's relationship. Even when the base time periods on which the regression equations are formulated extend over 20 years or more, basic economic changes may occur to change the relationship between the indicators and employment to a significant degree. Such changes invalidate the regression equations. Moreover, as the economy continues expanding and economic indicators therefore increase, the indicators inevitably attain levels which were not included in the initial formulation of the regression equations. It is thus altogether possible that, at these higher levels of the economic indicators, the relationship with employment levels is unstable or no longer linear.

F. The Method of Planned Industrial Construction

This method is designed to predict the expanded regional manpower requirements resulting from projected regional economic growth. The basis for the manpower projections are plans for industrial construction (Beyon, 1966).

In this method, data are collected concerning the manner in which existing buildings within a given region are utilized, the total number of employees working within the buildings, and building sizes. These data are then analyzed to determine building size-to-employment level ratios for different industries, and other relevant information. National industry-by-occupation distributions are applied to this employment-level data to estimate crudely the number of workers within various occupational categories within the region.

Information on the projected size and function of new buildings is gathered from plans and announcements of industrial construction. From this information on new building, total employment level within them may be estimated. The national industry-by-occupation distributions are then to estimate the total number of workers within various occupational categories that will be working within the new buildings. In order to assess actual regional increases in manpower requirements, it is necessary to determine whether employees within the new buildings are being transferred from other sites within the region, or whether the new buildings are indicative of

genuine regional economic expansion.

This method is potentially noncumbersome, relatively inexpensive and, when used independently, very inaccurate. In addition to the general problems previously reviewed in applying national industry-by-occupation matrices to particular regions, there are several difficulties associated with using construction plans as a sole regional economic indicator. Buildings are not always used in the ways that they were intended to be used, nor are they necessarily going to be filled to capacity (or any other particular level of building utilization upon which the manpower projections might be based). In addition, the technique may not be used to estimate changes in the mix of manpower requirements within selected regions, nor regional downtrends for jobs within occupational categories.

In modified form, the technique may be used for first-order approximations of labor market increases which can then be augmented with other types of analyses.

G. The Method of More Advanced Economies

The method of more advanced economies is based upon the supposition that manpower projections for one economy may be made by studying the antecedent manpower requirements of more advanced economies. Thus manpower models have been constructed for some developing countries by using historical economic data from the United States (Parnes, 1965). There have also been examinations of the extent to which early changes in the occupational structure of the labor force in advanced countries can be used to anticipate such changes in less advanced countries (e.g., Farrag, 1967).

There is little supporting evidence to suggest that the method of advanced economies could be applied for general manpower projection purposes in a manner that would be useful for occupational education planners. This approach cannot lead to systematic regionalized manpower projections across a large number of occupational categories since the previous economic conditions of one region will nearly always differ in significant ways from the present economic conditions of the regions for which manpower projections are required.

However, some of the assumptions underlying the method of advanced economies have been used for a variety of special industry studies. The impact upon manpower requirements of a given new industry in a region might be at least analogous to the impact upon manpower requirements of a similar industry

moving into another region. Thus a study of manpower effects in one region can provide information which may lead to manpower estimates for another. To the extent that studies of this type are available, they may be used along with other information by occupational education planners to determine changes in the mix of program offerings within regions in which new industry is expected.

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